FEBRUARY 1960—SIXTY-SIXTH YEAR

Machinery

Bliss' new Rolling Bolster Press...

...gets the most from each man hour! More than twenty of these new Bliss presses have already been ordered by a major automotive producer! How much money could this new press development save your stamping department? Operators can change dies while the new Bliss rolling bolster press is running... when the press run is finished, a bolster rolls in with the new dies already in place and the press is ready to go again in minutes. Result: the Rolling Bolster Press is producing stampings 90% of the time as compared to 40% efficiency for conventional straight side presses. It is adaptable to either long- or short-run production operations. We'll be glad to give you details.

BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name... it's a guarantee

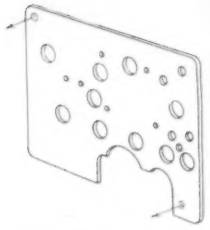
Bore 23 holes on 1 machine

Heald Model O Bore-Matic solves multiple-hole Borizing problem with interchangeable Multi-Spindle Heads

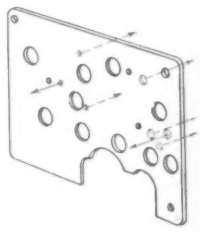
The Problem—to precision bore 23 holes, ranging from .0365" to .3570" in diameter, in medium-hard aluminum gear-box plates, with a tolerance of .0005" on diameter and .0009" on centers—also to bore 12 similar holes in a matching plate.

The Solution—a Heald double-end Model O Bore-Matic equipped with two sets of interchangeable Multi-Spindle boringheads. As shown in the drawings at the right, the 23-hole plate is precision Borized to the required tolerances in only three operations, using an indexing cross-slide and with all holes accurately positioned by cross-slide index and spindle location. One set of Multi-Spindle heads is used for the first two operations—then spindle plates are changed for the final operation. The second set of spindle plates also finishes all bores in the 12-hole plate in two operations. Average production is 10 parts per hour.

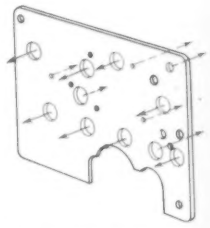
Heald Multi-Spindle boringheads consist of interchangeable spindle plates, precision bored to mount the desired number of miniature Red-Head boringheads which are belt-driven from a single motor. This arrangement permits simultaneous Borizing of multiple holes with center distances as close as 3/4". To save production time and cost on your multiple-hole borizing jobs, ask your Heald engineer for complete information on Model O Bore-Matics.



1. Bore two locating holes in single-end cycle using spindle plate No. 1.



2. Bore 7 holes in double-end cycle using spindle plates No. 1 and 2.



3. Replace spindle plates No. 1 and 2 with No. 3 and 4 and bore 14 holes in double-end cycle.

(Arrows show direction of table travel for holes indicated)

HEALD®

MMT=pE

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

FEBRUARY 1960

VOL. 66 No. 6

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BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

Automatic Methods Play Big Role in Hydra-Matic Torus Fabrication ..... Raymond H. Spiotta 103
Flexible Production of V-6 and V-12 Engine Blocks 115
Helical-Keyed Drive-Shaft is Heart of Torque-Sensing Mechanism Samuel Herman 121
Cable Tension Operates Work-Clamping Levers ..... Herbert Chase 124
Mechanized Equipment Expedites Handling of Automotive Sheet Metal ..... Herbert Chase 125
New Instrument Provides Direct Monitoring of Lathe-Tool Position 129
One Furnace—Two Quenches ..... Carl G. Paulson 131
Grinding Special Rolls with Crush-Trued Wheels 133

MACHINE AND TOOL DESIGN

Calculations for Deep Drawing of Flanged Shells ..... Kurt Heber 111
Circular Knife-Edges Locate and Grip Thin Castings ..... H. J. Gerber 135
Form Die for An Unusual Part ..... Roger Isetts 136
Device for Drilling Two Small Holes Close Together ..... Ernest Jones 137
MACHINERY's Ingenious Mechanisms Competition 140
Dial's Moving Witness Mark Compensates for Backlash ..... Clint McLaughlin 141
Cam Eliminates Shock in Rack Movement ..... Ralph T. Stewart 142

MANAGEMENT PROBLEMS

Progress on Parade ..... Charles O. Herb 101
Pretest—to Prevent Failure ..... Bernard Lester 134

REFERENCE SECTION

New Tables Simplify Helical-Spring "Arithmetic"—Part I ... Peter F. Rossmann 147

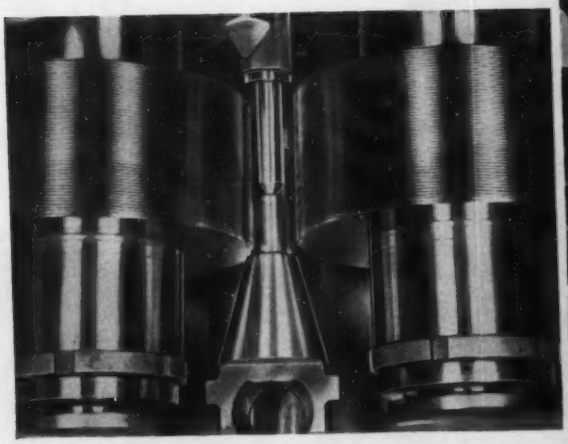
DEPARTMENTS

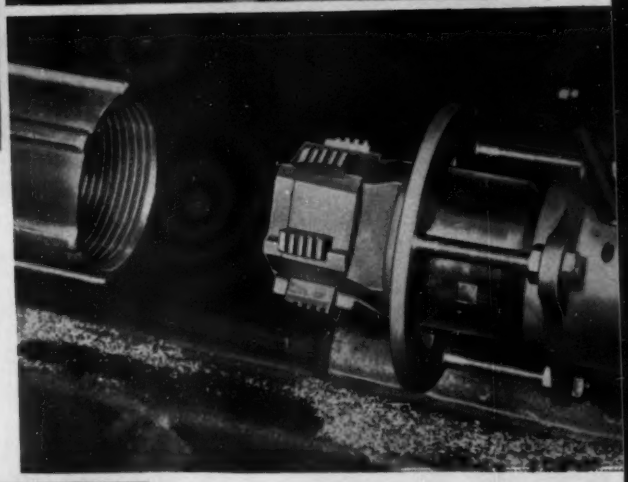
Keeping Up with Washington 99
Talking with Sales Managers 134
Tool Engineering Ideas 135
Shop Kinks 138
Ingenious Mechanisms 141
Materials 144
In Shops Around the Country 158
Latest Developments in Shop Equipment 160
New Catalogues 199
Between Grinds 206
News of the Industry 208

PRODUCT DIRECTORY 222

ADVERTISERS' INDEX 297

Only Landis cuts, rolls, taps,





grinds threads

Cutting threads on double-end studs at Kilbourn Engineering Co., Milwaukee, Wisconsin

Rolling threads on jet engine mountings at Liston Grinding Co., Tonawanda, N. Y.

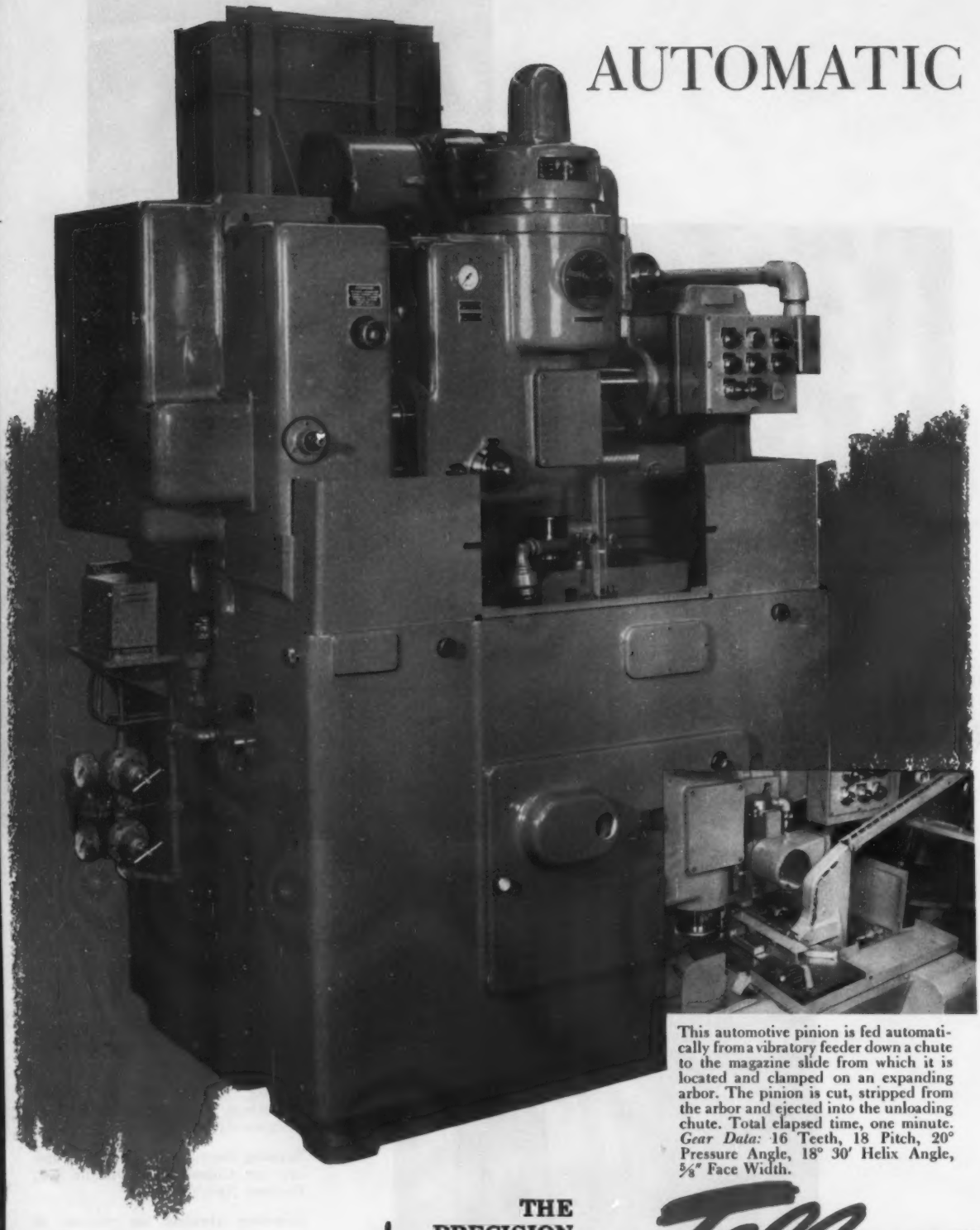
Tapping threads in cylinder retainer caps at Cleveland Hydraulic Co., Bedford Heights, Ohio

Grinding threads on worms at Bendix-Westinghouse, Elyria, Ohio

LANDIS *Machine* COMPANY WAYNESBORO • PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

AUTOMATIC



This automotive pinion is fed automatically from a vibratory feeder down a chute to the magazine slide from which it is located and clamped on an expanding arbor. The pinion is cut, stripped from the arbor and ejected into the unloading chute. Total elapsed time, one minute. *Gear Data:* 16 Teeth, 18 Pitch, 20° Pressure Angle, 18° 30′ Helix Angle, 5/8″ Face Width.

THE PRECISION LINE

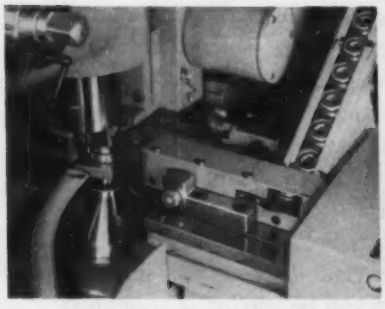
Fellows

WORK HANDLING
Is A Natural Complement to the High Production Rates of the Fellows 4GS Gear Shaper

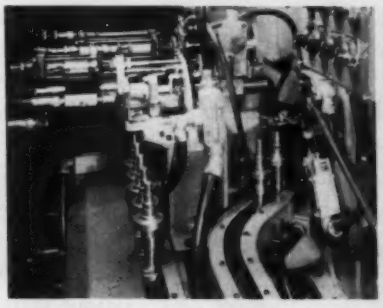
Although designed for both manual and automatic loading, the 4GS Fellows Gear Shaper makes best use of its high production rates when equipped with work handling devices.

The physical construction of the machine is such that it may be easily adapted for use with magazines and chutes for automatic loading and unloading at substantial cost savings on continuous production runs.

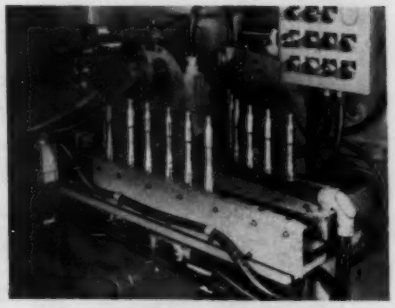
Ask your Fellows representative about the many advantages of automatic work handling with the 4GS Fellows Gear Shaper, or write direct to the Fellows Gear Shaper Company.



These internal clutch parts are handled in the same manner as the 16-tooth external pinion, except that the cutter-spindle is automatically stopped at the top of its stroke for clearance during the loading and unloading cycle. Cutting time is 1½ minutes. *Gear Data:* 10 Teeth, 12.4 Pitch (Stubbed), 30° Pressure Angle, Spur, 5/32" Face Width.



This transmission cluster gear shaft is handled by two sets of air-operated "fingers" mounted on a turret. As the turret rotates, one set of fingers moves the finished piece to the unloading chute while the other set brings the new blank into position. Cutting time is 35 seconds. *Gear Data:* 10 Teeth, 12.4 Pitch (Stubbed), 30° Pressure Angle, External Spur, 5/32" Face Width.



This automotive stem pinion is handled in the same manner as the cluster gear. In both cases, safety devices prevent the machine from starting unless the blanks are in the correct cutting position. Loading and unloading chutes may be hand or conveyor fed. Cutting time is 2½ minutes. *Gear Data:* 17 Teeth, 10 Pitch, 19° 30′ Pressure Angle, 32° 51′ Helix Angle, 5/8" Face Width.

Gear Production Equipment

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont, U. S. A.
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

For more data circle this page number on card at back of book

CINCINNATI ACRAMATIC . . .

complete integration of numerical control and machine design

Here is a simplified numerical control system that brings to more and more shops the cost-saving benefits of this efficient manufacturing concept. This system realizes the full potential of numerical control because all its elements are completely coordinated from their inception under the single responsibility of The Cincinnati Milling Machine Co. . . . where numerical control specialists work hand in hand with machine tool designers, and application and methods engineers.

ACRAMATIC is a simpler, more adaptable system for either positioning or contouring, with a number of practical advantages that reduce the time and cost of both programming and machining . . .

Simplified Contour Programming, requiring less input data because of exclusive parabolic interpolation method.

Cutting Tool Compensation permits change of cutters without change in programming.

Zero Shift Control eliminates need for exact positioning of work on table.

Automatic Repositioning — all dimensions are established from a single base point.

Feed Rate Override allows manual adjustment of feeds below programmed rates.

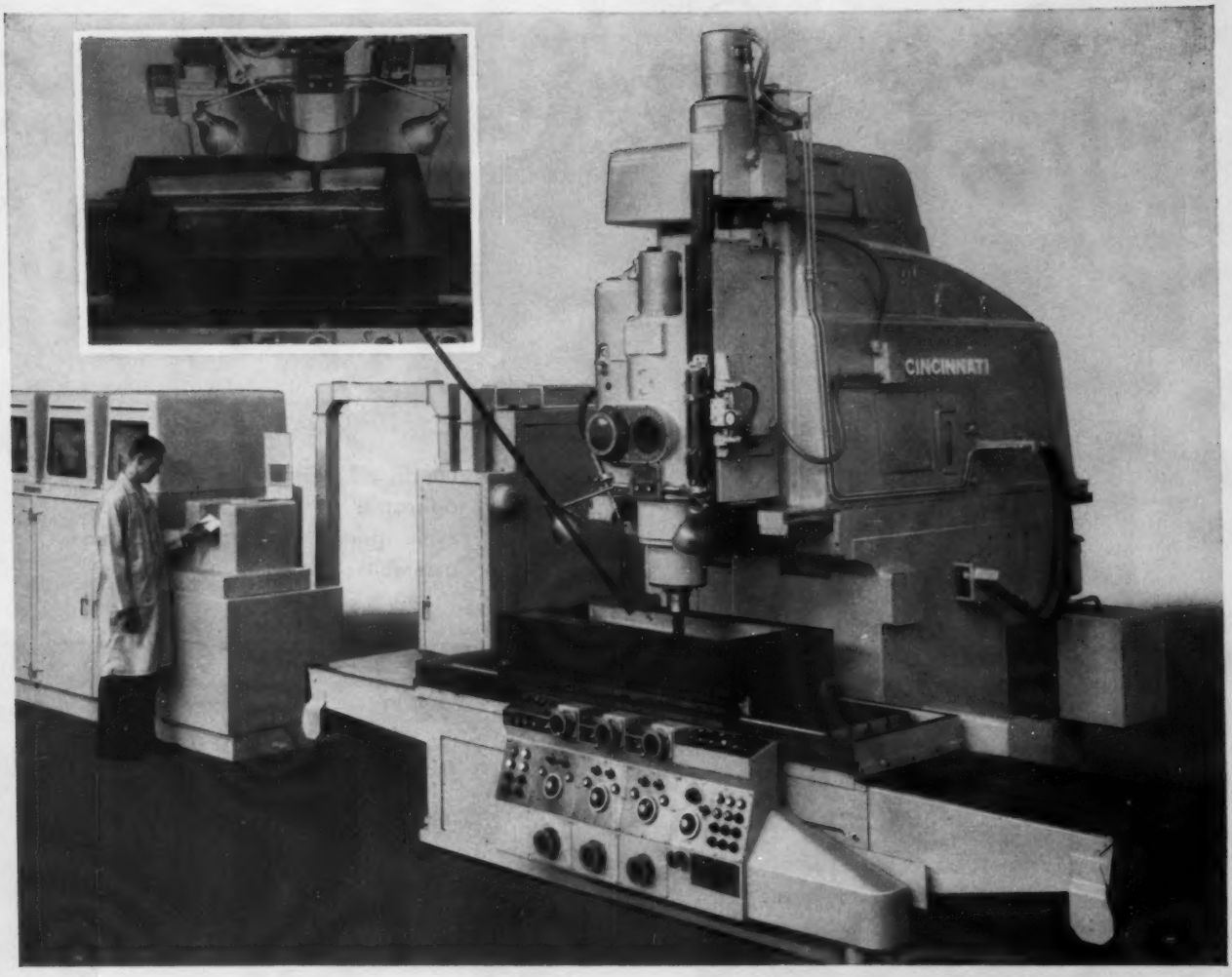
Accuracy unaffected by varying line voltages, because dimensions are represented by voltage ratios.

There are many other ways in which CINCINNATI ACRAMATIC takes full advantage of the possibilities of numerical control. General information is contained in Publication M-2125, or our Application Engineers will be glad to show you how this unique system can be applied in your shop. May we hear from you?

The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

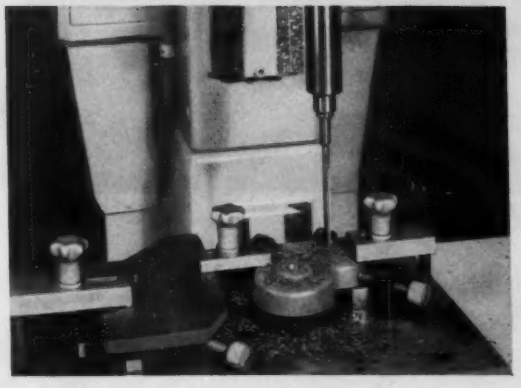
CINCINNATI

BUILDERS OF FINE MACHINE TOOLS: MILLING • GRINDING • BROACHING • ELECTRICAL DISCHARGE MACHINING • DIE SINKING • CUTTER AND TOOL GRINDING • PRODUCTION LINES • METAL FORMING • • HARDENING MACHINES



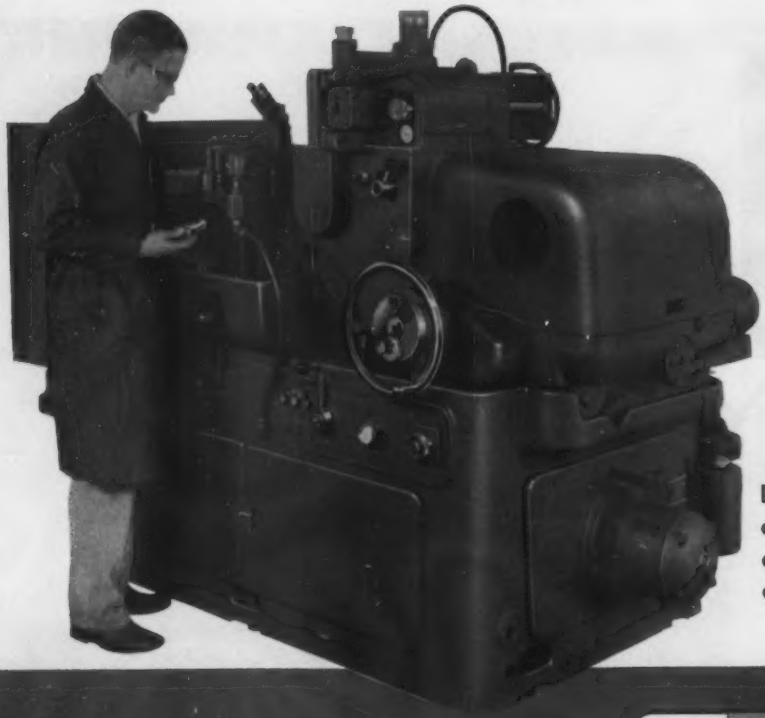
Above: CINCINNATI 30" x 52" Vertical Hydro-Tel equipped with CINCINNATI ACRAMATIC 3-Axis contour control, performing a die sinking operation on a die for a milling machine motor compartment cover. ACRAMATIC's exclusive parabolic interpolation method programmed this entire complex operation using only 2000 punched cards for the twenty hours of machining required.

At right: CINCINNATI ACRAMATIC 2-Axis Positioning Control automatically provides fast, accurate hole location. Programming requires only the typing of an eight-digit number for each hole location.



CINCINNATI®

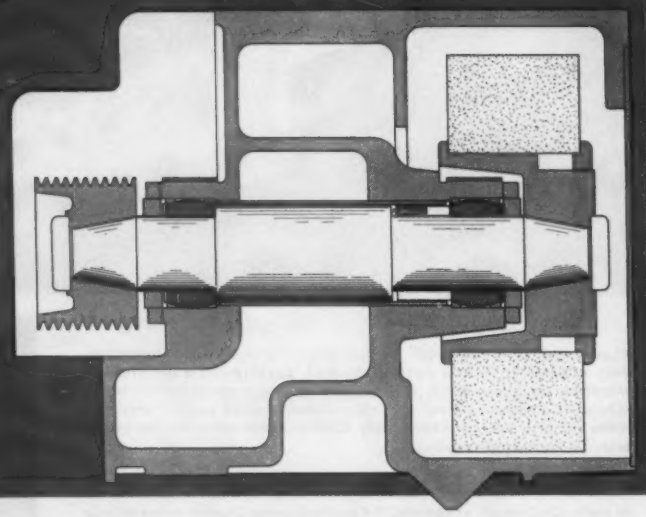
Two exclusive Landis Centerless features for maximum production and precision



Landis #12 Centerless with power operated loader and automatic cycle grinds 380 special piston assemblies per hour.

Rigidized Spindles

Increased diameter between bearings provides greater rigidity for fine finishes. Microsphere bearings telescoped into wheel centers for maximum stability under heaviest cuts.



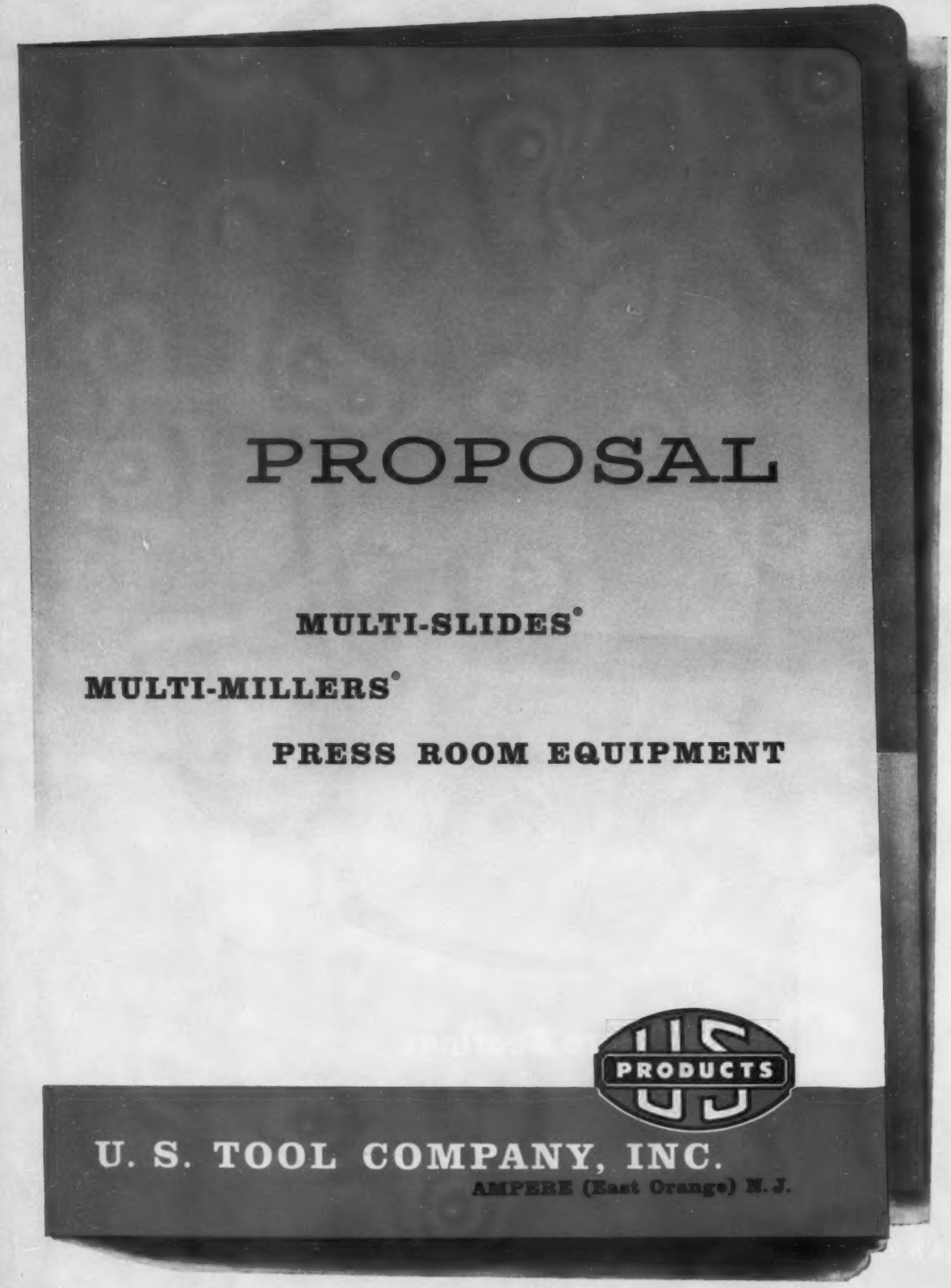
LANDIS

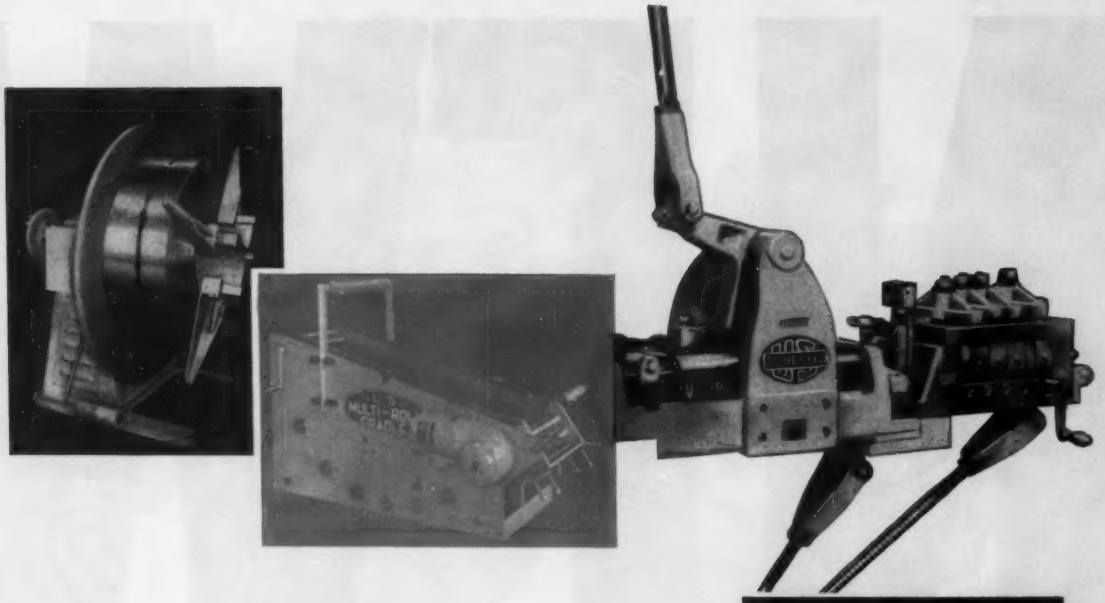
precision grinders

Microsphere Bearings

Close running clearance gives faster sparkout and accurate response to feed changes. Simple, one piece bearings with babbitt lining for long life and dependable operation.

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA


PROPOSAL
MULTI-SLIDES®
MULTI-MILLERS®
PRESS ROOM EQUIPMENT
US
PRODUCTS
U. S. TOOL COMPANY, INC.
AMPERE (East Orange) N. J.

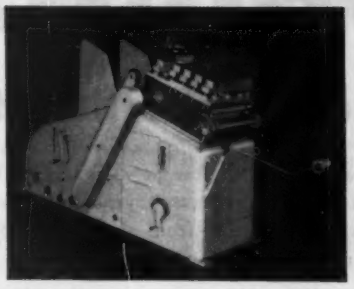


PROPOSAL

FOR PROFITABLE PUNCH PRESS PRODUCTION

When the familiar orange and black U. S. Tool Proposal reaches your desk you are on the road to Punch Press Production that will please the most pessimistic.

There is no "high pressure" in a U. S. Proposal. Each one details our method of handling the material for the particular metal stamping project involved. You get the facts . . . you get the figures.



To insure positive Punch Press feeding, major press manufacturers often specify U. S. Feeds and U. S. Stock Straighteners as original equipment. They do so because they know that **Profitable** Punch Press Production depends upon the utmost efficiency, from coil stock to finished stamping.

Consider your present equipment — is it really set-up for **Profitable** Punch Press Production? If not, let us submit our PROPOSAL to help you achieve greater efficiency and economy in your stamping operations.

Send for Bulletins No. 85M and 151M.

Illustrated here are (reading from top to bottom): ACR-1642 U. S. Automatic Centralizing Reel; ACC-1648 U. S. Automatic Coil Cradle; SF-68A U. S. Slide Feed with Plain Straightener; PDS-16H U. S. Power Driven Straightener; PDSC-1648 U. S. Combination Cradle-Straightener.

U. S. TOOL COMPANY, INC.

AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

For more data circle this page number on card at back of book

NEW

WARNER & SWASEY

Unique, Automatic Headstock

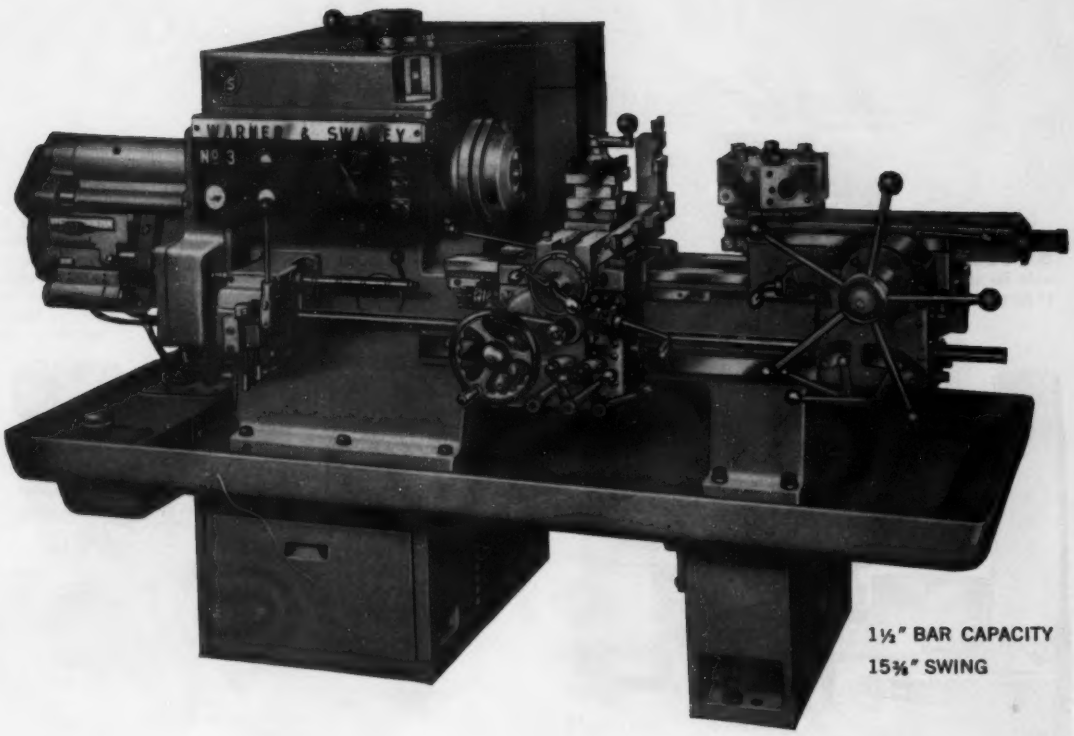
More Speeds – Greater Range – The new eight-speed headstock (16 with a two-speed motor) gives you more speeds in a wider range – from 45 to 2262 rpm – for maximum metal removal efficiency.

Instant Speed Changes throughout the full range are made possible through exclusive, Warner & Swasey designed direct-acting hydraulic clutches (which never need adjustment) in combination with a constant mesh, helical gear train. Time loss for gear shifting in conventional headstock gear trains is eliminated.

Full Power is always available at the spindle nose by the higher-powered, direct-mounted motor. Direct mounting also eliminates motor-drive maintenance problems.

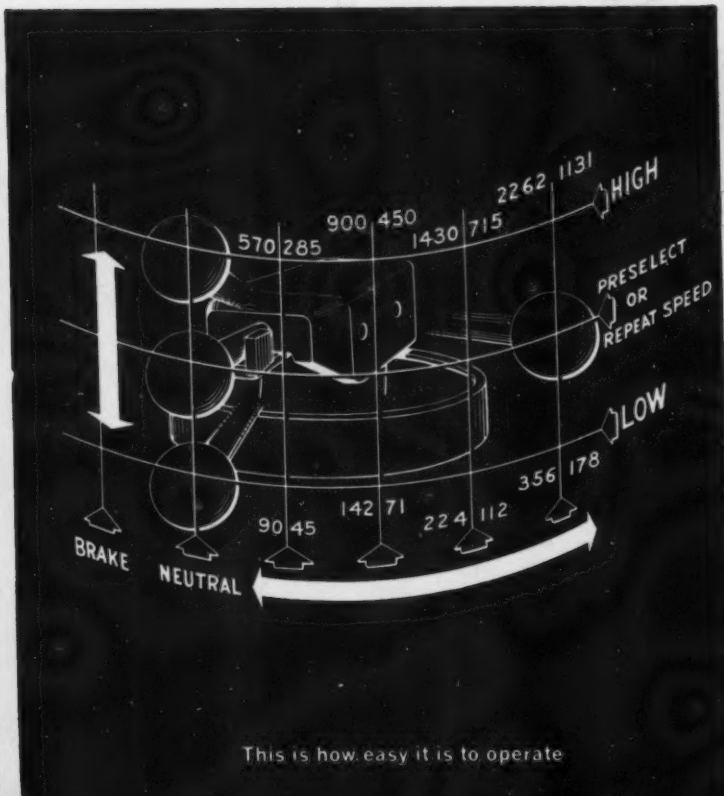
New, Rugged Bar Feed and Collet Chuck are hydraulically operated with single-lever control for easy, fast handling. The wider base and rigid construction of the bar feed permits greater accuracy and smoother work finishes on high-speed, heavy-duty work.

This is the new exclusive single lever headstock control . . .



1½" BAR CAPACITY
15¾" SWING

No.3 ram type turret lathe



This is how easy it is to operate

Exclusive, Single Lever Preselector and Speed Control

Control of spindle speeds is now an easy one-hand operation on the new No. 3! Preselection of speeds, speed change, brake and neutral—all are obtained with the same lever!

No fumbling for speeds... no gear shifting. Just rotate the handle to preselect; move it up or down to engage new speed instantly.

No figuring... the direct reading preselector dial tells you the surface speed for each diameter and rpm.

No remembering (or forgetting)... the preselector drum lets you set up the sequence of cuts; numbered clips tell you where to find the speeds and their order of use.

Neutral (free spindle) and Brake are selected by rotating lever to the left.

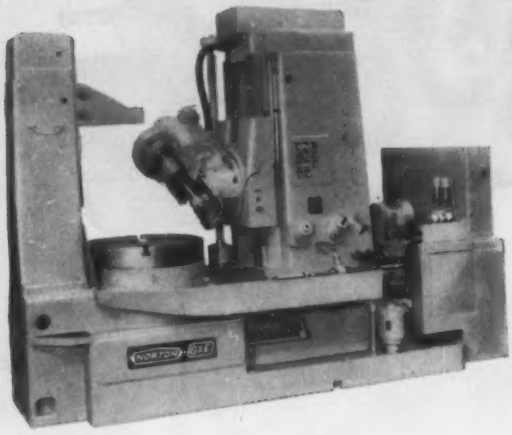
Forward and Reverse are controlled by a switch lever on front of headstock.

For free brochure write Warner & Swasey Company, Cleveland 3, Ohio.

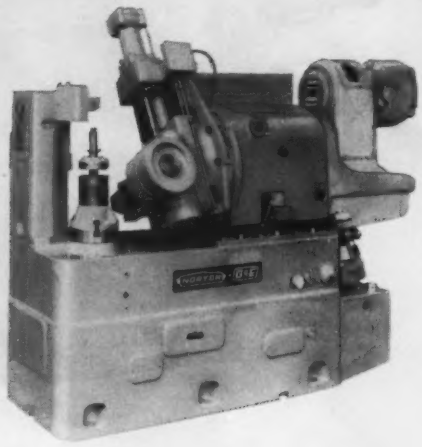
You can produce it better, faster, for less... with a WARNER & SWASEY

W S

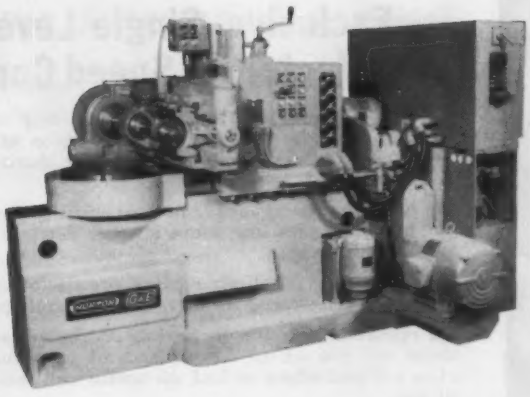
G & E Universal Gear Hobbers are available for commercial and precision production of spur and helical gears, up to 160" diameter.



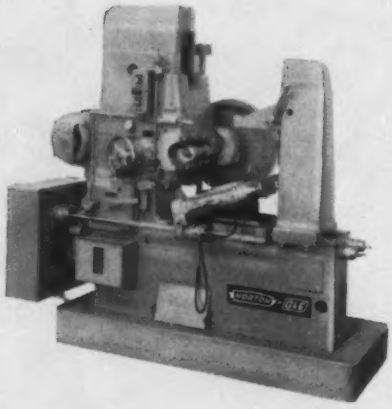
G & E 10HQ HOBLIQUE® Universal Gear Hobber is designed for high speed, high production hobbing of spur and helical gears up to 10" diameter.



Norton Welcomes G & E

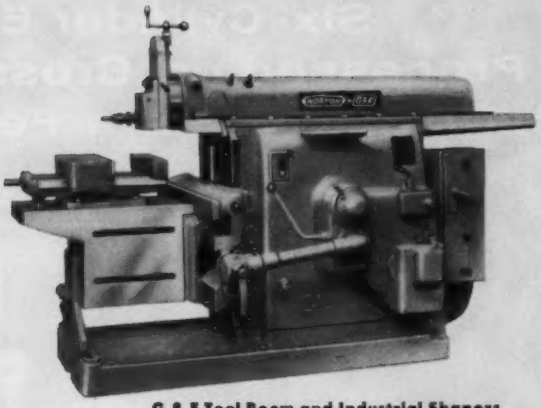


G & E Worm Gear Hobbers are long established leaders for fly tooling or hobbing commercial and precision worm gears up to 100" in diameter.



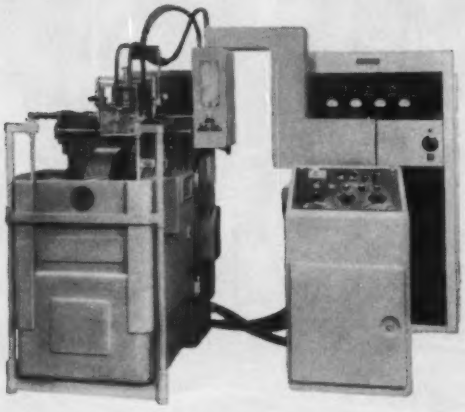
G & E Gear and Rack Cutting Equipment for automatically cutting a diversified range of spur and bevel gears, sprockets and racks.

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes



G & E Tool Room and Industrial Shapers meet every requirement for speed, accuracy and compactness on general work. Available in seven sizes from 14" to 36" stroke. Can be equipped with an hydraulic follower attachment.

G & E Delapena COLD HEAT® Gear-Tooth Induction Hardener employs a revolutionary new process for hardening gear tooth profiles. A patented intensifier operating under water, consistently produces a uniform hardness pattern, and reduces distortion to an absolute minimum.



. . . famous shapers and gear cutting machines join fast growing machine tool family

The addition of the Gould and Eberhardt Division expands capacity and adds a variety of products to the Norton line to serve you better in the Machine Tool field.

The G & E machines shown here are popular leaders in the broad line that will continue in its entirety. Transferal of the manufacture of these machines to Norton headquarters is accompanied by the technical know-how that has made G & E a long established, highly valued supply source of metal cutting equipment.

At Worcester, production of G & E machines is assured the top quality standards that have made Norton the world's largest supplier of grinding machines and lappers.

Norton will be glad to help you select the G & E equipment you need for the results you want. For further information or for G & E parts, write NORTON COMPANY, Gould & Eberhardt Division, Worcester 6, Massachusetts.

NORTON
MACHINE TOOLS
Making better products
. . . to make your products better

MACHINE TOOL DIVISION: Grinding and Lapping Machines — **G & E DIVISION:** Shapers • Gear Cutting Machines • Gear Induction Hardeners

Six-Cylinder Engines Now Processed on Cross Transfer-matics That Made V-8's a Few Months Ago

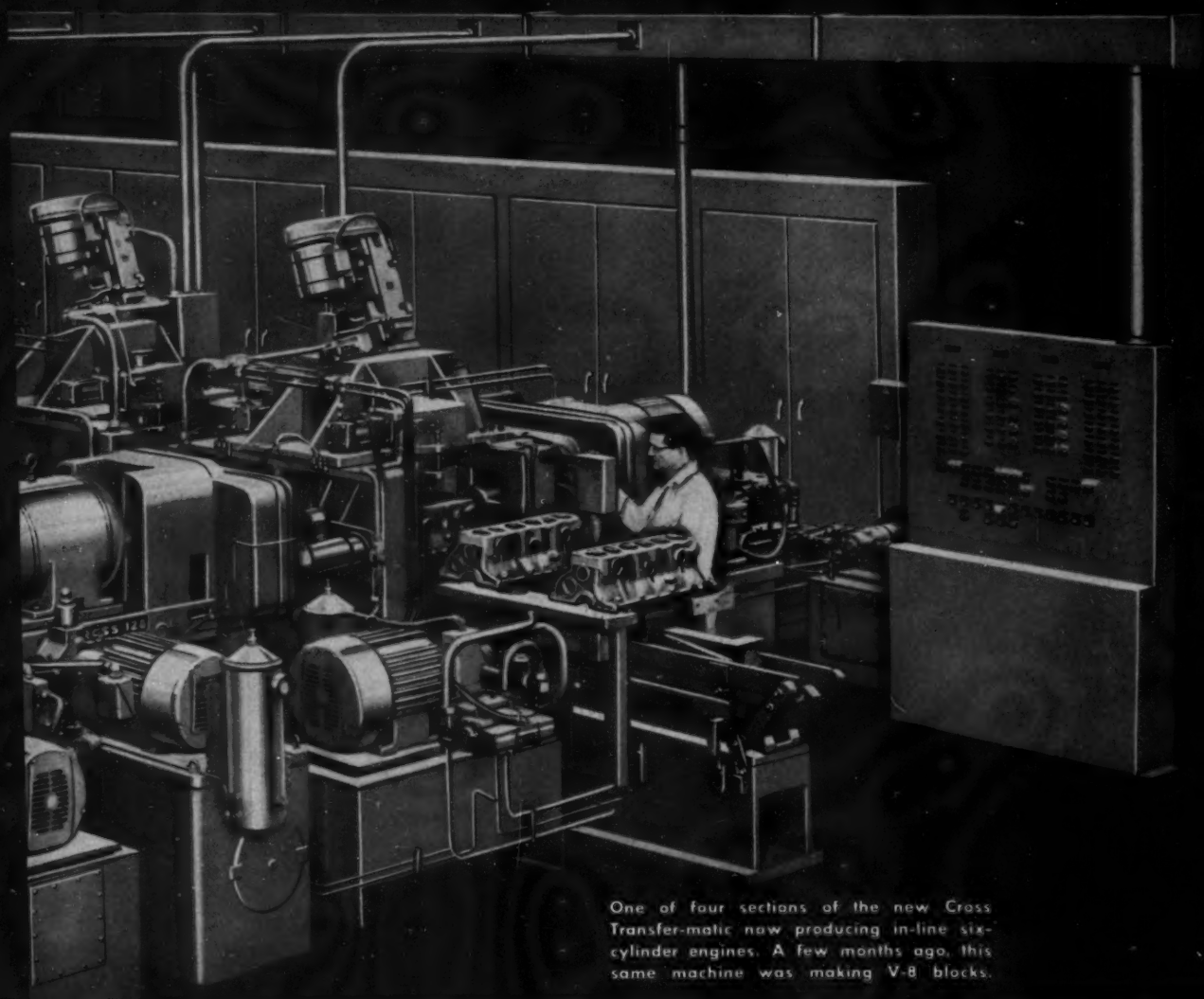
PART: In-line six-cylinder block.
OUTPUT: 100 per hour at 100%.
OPERATIONS: Milling, drilling, boring, reaming and tapping.

Cross "Building Block" Construction Permits Reworking Line at 40% of Original Cost

A few years ago Cross delivered, to a large automobile manufacturer, three Sectionized Transfer-matics for machining cylinder blocks for high powered V-8 engines. These machines introduced new concepts of flexibility by standardizing bases, transfer mechanisms, fixtures, heads and other component parts.

Last year, due to public demand, the car company had to make a quick switch from V-8 engines

Another Transfer-matic by Cross



One of four sections of the new Cross Transfer-matic now producing in-line six-cylinder engines. A few months ago, this same machine was making V-8 blocks.

to small in-line sixes. The new standards that Cross created for these Transfer-matics permitted the change to be made in a minimum amount of lead time and at a cost savings of 60%.

Today, one line is already producing in-line six-cylinder engine blocks and a second line is being converted for a production increase during 1960. This is proof positive that Cross engineered flexibility does pay off and that it costs no more.

Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

For more data circle this page number on card at back of book

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE

UNGROUND CLASS "C" HOBS, *made from Crucible's M2S, consistently meet runout tolerances as required.*

ACCURATE HOBS— WITHOUT GRINDING!

Toolmakers hold hob tolerances to less than 0.001" without finish grinding—because of improved manufacturing skills and continually improved Rex® High Speed Steels.

Today's toolmakers are not only producing accurate unground hobs to closer tolerances – they're also making them stronger, longer-lasting and with fewer grinding stresses.

What is behind this development? It's the skill of the toolmakers – combined with continuing Crucible developments that improve the quality of Rex High Speed Steels. Crucible tool steel metallurgists, working closely with producers of fine precision tools, are able to devise mill manufacturing practices to provide steels ideally suited to specific applications.

At Crucible, Rex High Speed Steels have always been produced under the close personal supervision of the most experienced men in the industry. Today, these men utilize the most advanced electronic instrumentation to assure the production of highest quality steels. For example, they use precision instruments to control the temperature of the molten metal, in the melting furnace, so each heat is produced under identical conditions. New techniques permit greatly improved deoxidation of the liquid steel. New ingot mold designs provide freedom from segregation when the steel solidifies. And all Rex High Speed Steel billets are inspected ultrasonically before they are rolled or forged.

As a result, Rex High Speed Steels continue to make the best hobs because they offer:

more uniform distribution of carbides throughout the section. This ensures minimum size change, greater predictability in heat treatment, greater hardenability and more uniform hardness in the heat-treated tool:

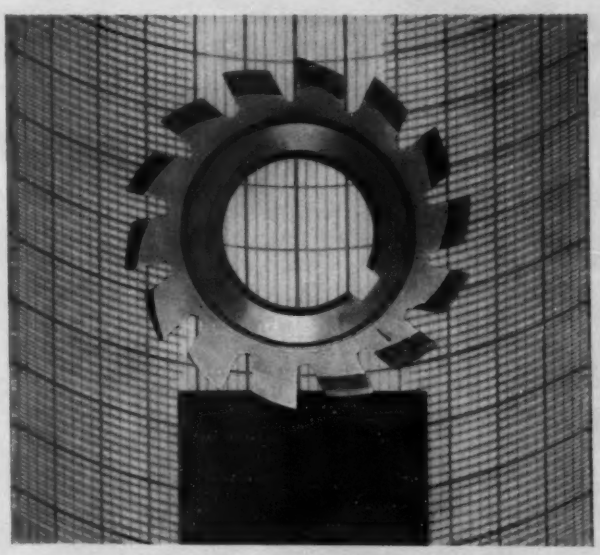
more uniform distribution of sulfides in the free-machining grades. And this provides improved machinability and superior surface finish.

Single-Thread Gear-Hob Tolerances (in Ten Thousandths of an Inch)

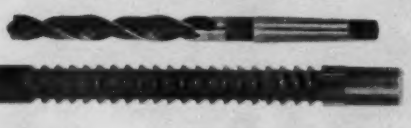
	DIAMETRAL PITCH										
	1 Thru 1.999	2 Thru 2.999	3 Thru 3.999	4 Thru 4.999	5 Thru 5.999	6 Thru 8.999	9 Thru 12.999	13 Thru 19.999	20 Thru 29.999	30 Thru 50.999	51 and Finer
RUNOUT											
Outside Dia. C	50	45	40	25	20	17	17	12	12	10	8

Table: Metal Cutting Tool Handbook

FINAL PROOF OF A HOB'S ACCURACY. *This lead variation chart, produced by a special electronic recorder, provides a check of every tooth in the hob. Checks are made "against perfection" — so, any deviation shows up on the chart. Photomicrograph shows tooth area's structure and the uniform distribution of carbides in Crucible Rex M2S. (Photo: 100X dia.)*



BETTER TOOLS, THROUGH BETTER STEELS. *The constant improvement of Rex High Speed Steels ensures the increasingly greater performance of fine twist drills, taps, broaches and cutters — as well as hobs.*



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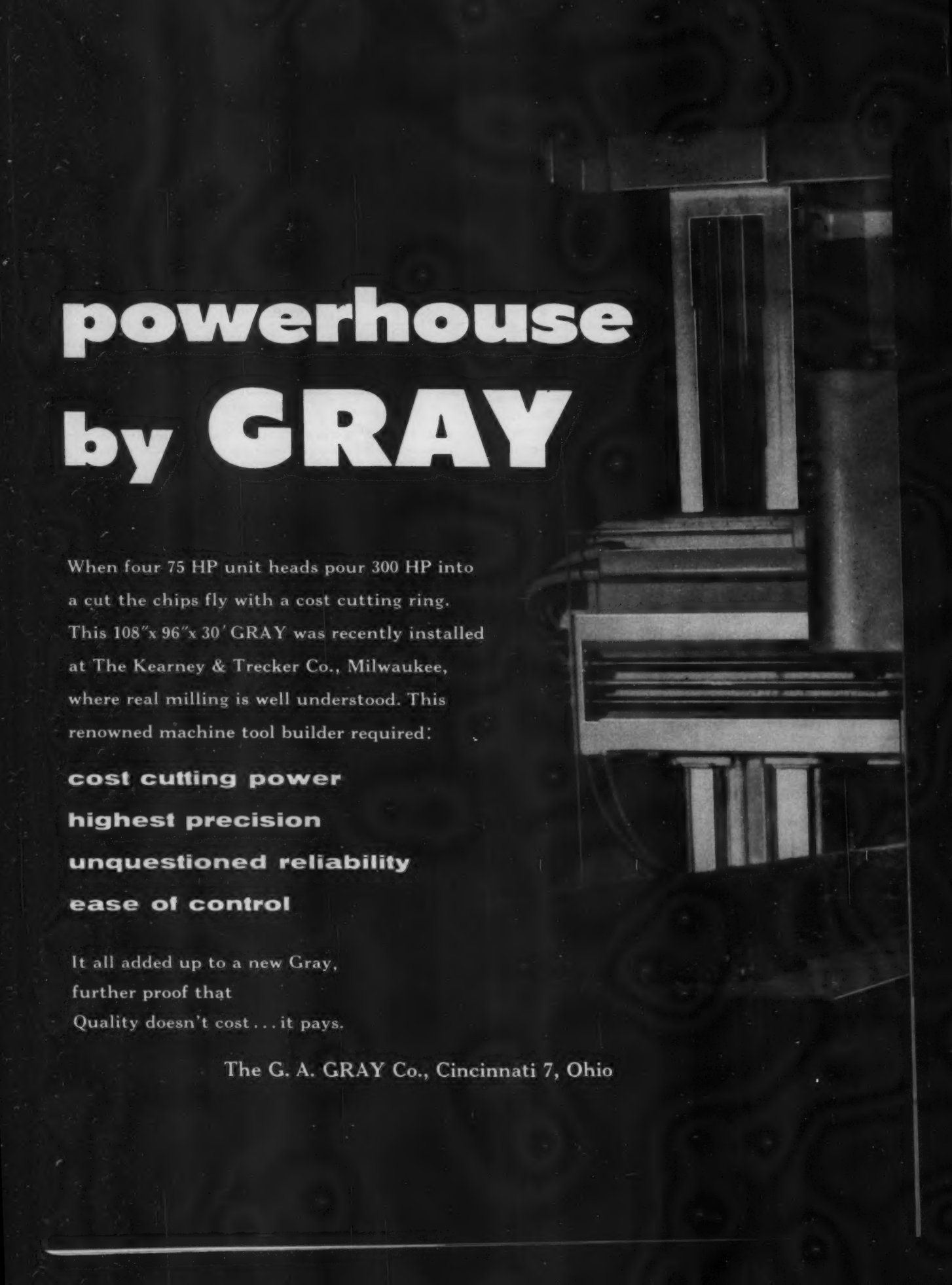


powerhouse by GRAY

When four 75 HP unit heads pour 300 HP into a cut the chips fly with a cost cutting ring. This 108″x 96″x 30′ GRAY was recently installed at The Kearney & Trecker Co., Milwaukee, where real milling is well understood. This renowned machine tool builder required:

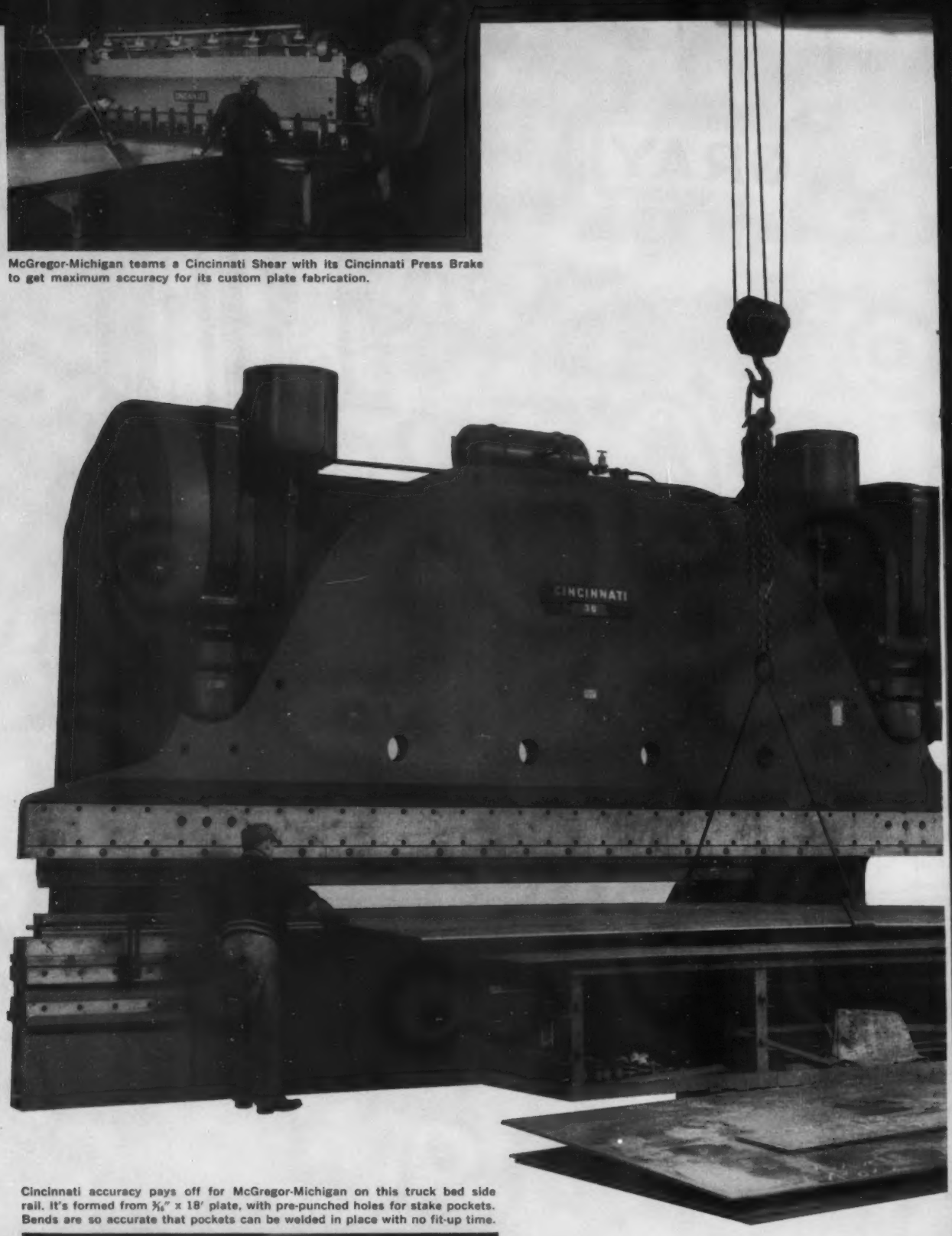
cost cutting power
highest precision
unquestioned reliability
ease of control

It all added up to a new Gray,
further proof that
Quality doesn't cost . . . it pays.

The G. A. GRAY Co., Cincinnati 7, Ohio

GRAY

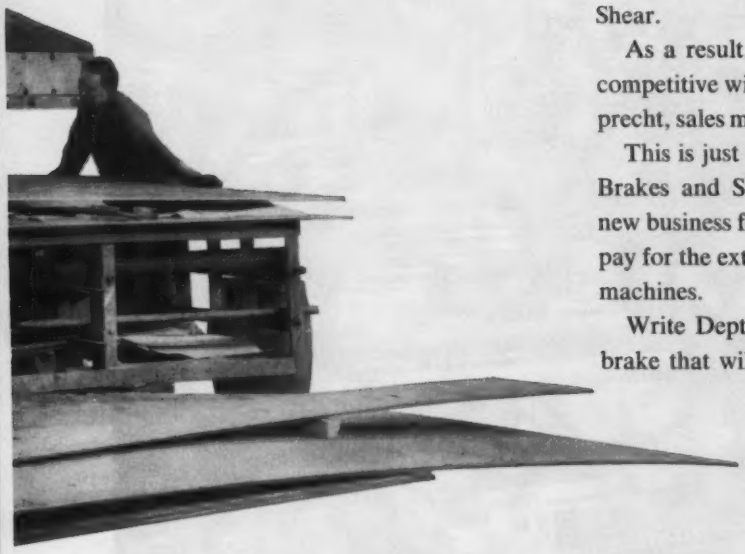
McGregor-Michigan teams a Cincinnati Shear with its Cincinnati Press Brake to get maximum accuracy for its custom plate fabrication.



Cincinnati accuracy pays off for McGregor-Michigan on this truck bed side rail. It's formed from 3/16" x 18' plate, with pre-punched holes for stake pockets. Bends are so accurate that pockets can be welded in place with no fit-up time.

This CINCINNATI® PRESS BRAKE means

bigger jobs
fewer weld seams
less handling
easier operation



All four of these advantages mean money to McGregor-Michigan Corporation, Detroit. And they got all four of them when they bought a 36 Series Cincinnati Press Brake to be used along with their Cincinnati All-Steel Shear.

As a result, "this new brake . . . helps us be more competitive with some of the larger shops," says R. Hilprecht, sales manager of this steel plate fabrication shop.

This is just one example of the way Cincinnati Press Brakes and Shears are cutting costs and opening up new business for shops across the country. They quickly pay for the extra refinements you get in Cincinnati-built machines.

Write Dept. D for new Catalog B-12, and pick the brake that will mean new profits for you.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

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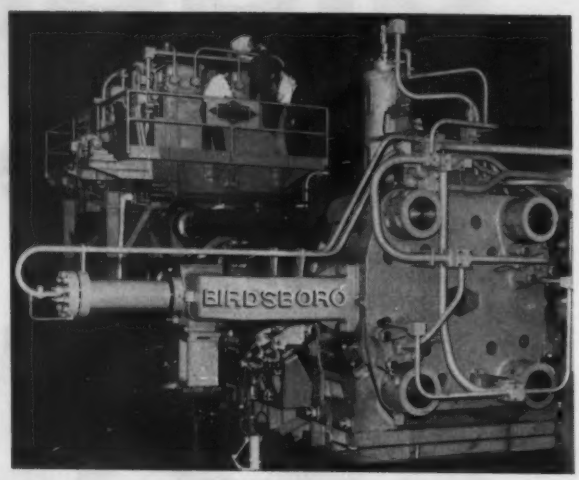
Extrusion Presses for aluminum, magnesium, copper, titanium, brass, steel . . . 1,000 to 12,000 tons . . . production primed

by BIRDSBORO

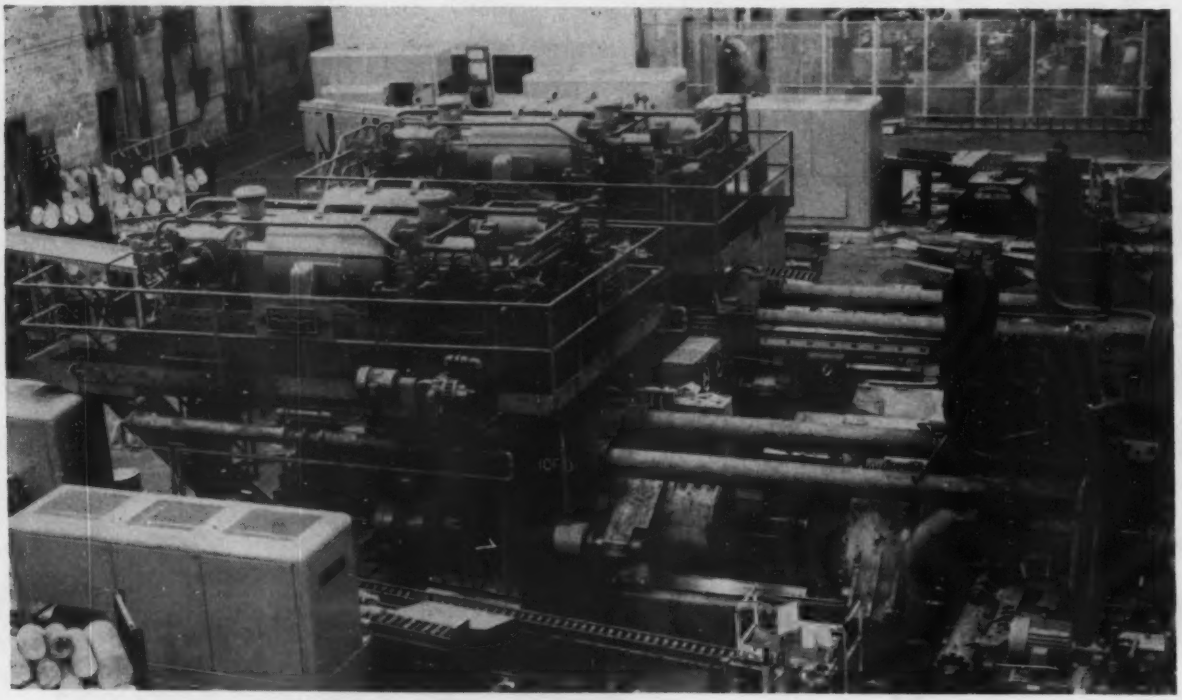
• Engineered to produce profitably for you . . . BIRDSBORO oil or water operated Extrusion Presses have several design innovations that will help you meet expanding productivity schedules for years to come. These versatile presses are capable of producing a broad range of sections and tubing of round, rectangular and irregular shapes.

For example, the press shown to the right is an unusually fast-acting 3,000-ton oil hydraulic extrusion press that substantially reduces dead cycle time. A unique die slide arrangement provides an alternate location for inserting, removing, dressing or adjusting a second die while extrusion continues uninterrupted.



The press shown below is another example. This 2,750-ton self-contained, oil hydraulic four-column aluminum extrusion press is engineered to extrude shapes from billets of 8 to 12 inches in diameter, and up to 32 inches in length.

Contact your BIRDSBORO representative for a more comprehensive picture. *Sales Department:* Reading, Pa., *Engineering Department and Mfg. Plant:* Birdsboro, Pa. *District Office:* Pittsburgh, Pa.



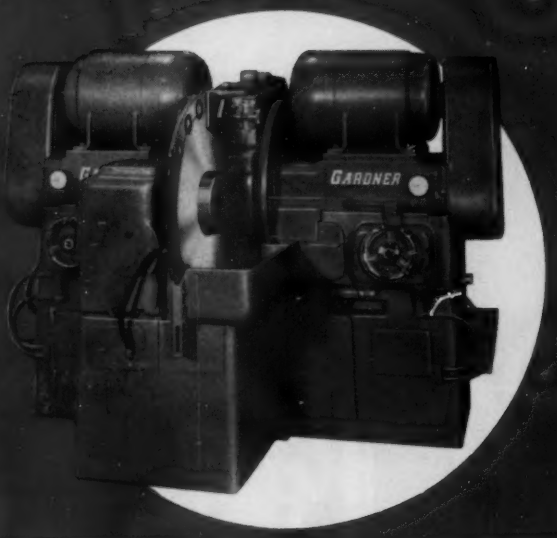
HP44-60

BIRDSBORO HYDRAULIC

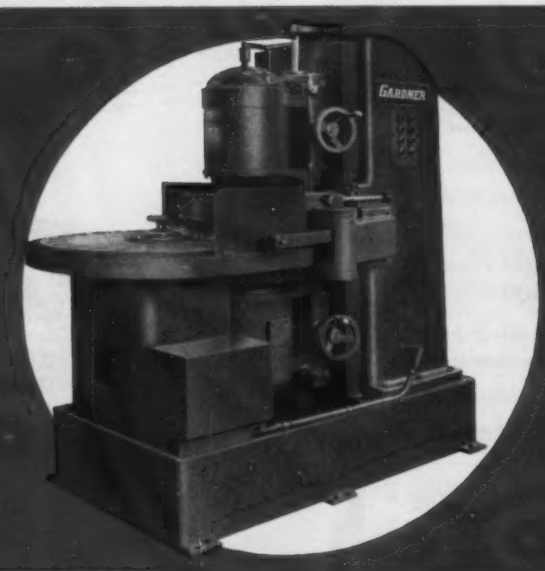
BIRDSBORO CORPORATION

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel.

Single Spindle Disc Grinders—For production grinding single surfaces. Manual and power-operated work-carrying fixtures available.



Precision Double Spindle Disc Grinders — Grind TWO parallel surfaces in ONE operation. Rotary, feed thru or gun type work fixturing.



Precision Vertical Double Spindle Disc Grinders— Grind TWO parallel surfaces in ONE operation. Springs and miscellaneous small parts for watches, business machines, electronic applications . . . metallic and non-metallic materials.

Special Purpose Disc Grinders—For parallel surfaces, sequence grinding, generating curved surfaces . . . single or multiple surfaces.

a full line of precision disc grinders for high production, high quality flat surfacing . . .

For information send for Condensed General Catalog

GARDNER

precision disc grinders

BELOIT, WISCONSIN

LAKE ERIE HYDRAULIC PRESSES

where engineering makes the difference

LAKE ERIE MAKES GOOD

Lake Erie has recently built some of the world's largest and most highly engineered presses

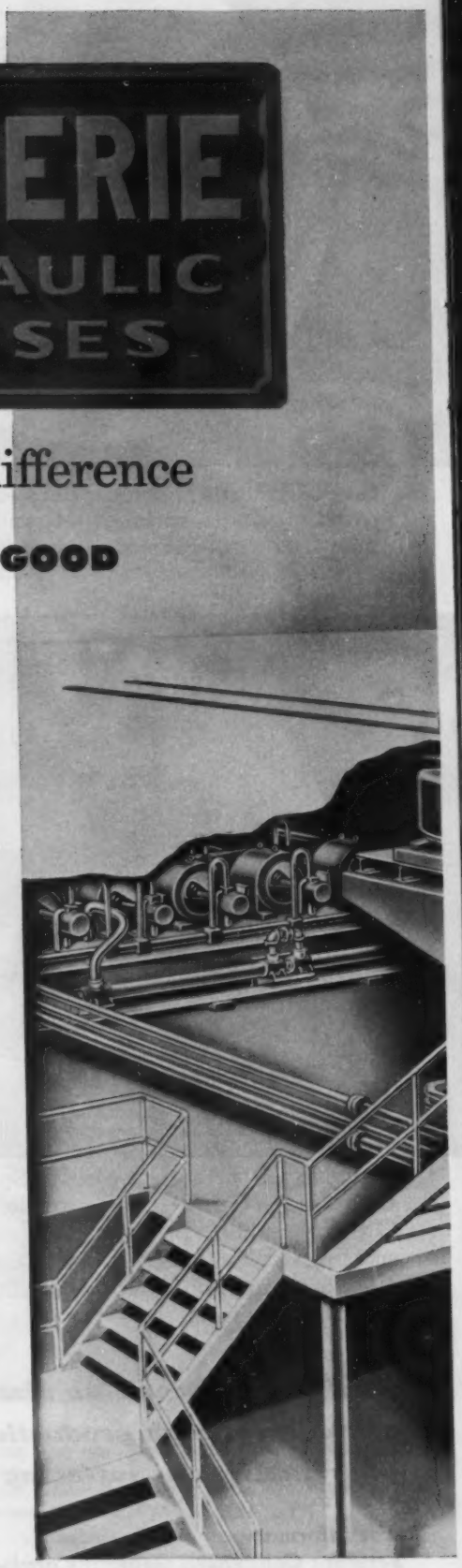
- **Pictured at right—a self-contained 2000 ton forging press for Allegheny Ludlum Steel Corporation.**
- **A 6500 ton briquetting press for Titanium Metals Corporation of America.**
- **A vertical copper extrusion press—said to be the world's largest —for Scovill Manufacturing Co. (2500 tons capacity).**
- **A 10,000 ton combination drawing and stretch forming press with a 24 foot x 9′ 3″ bed for McDonnell Aircraft Corporation.**

Right now Lake Erie is building more of the world's largest and most highly engineered presses

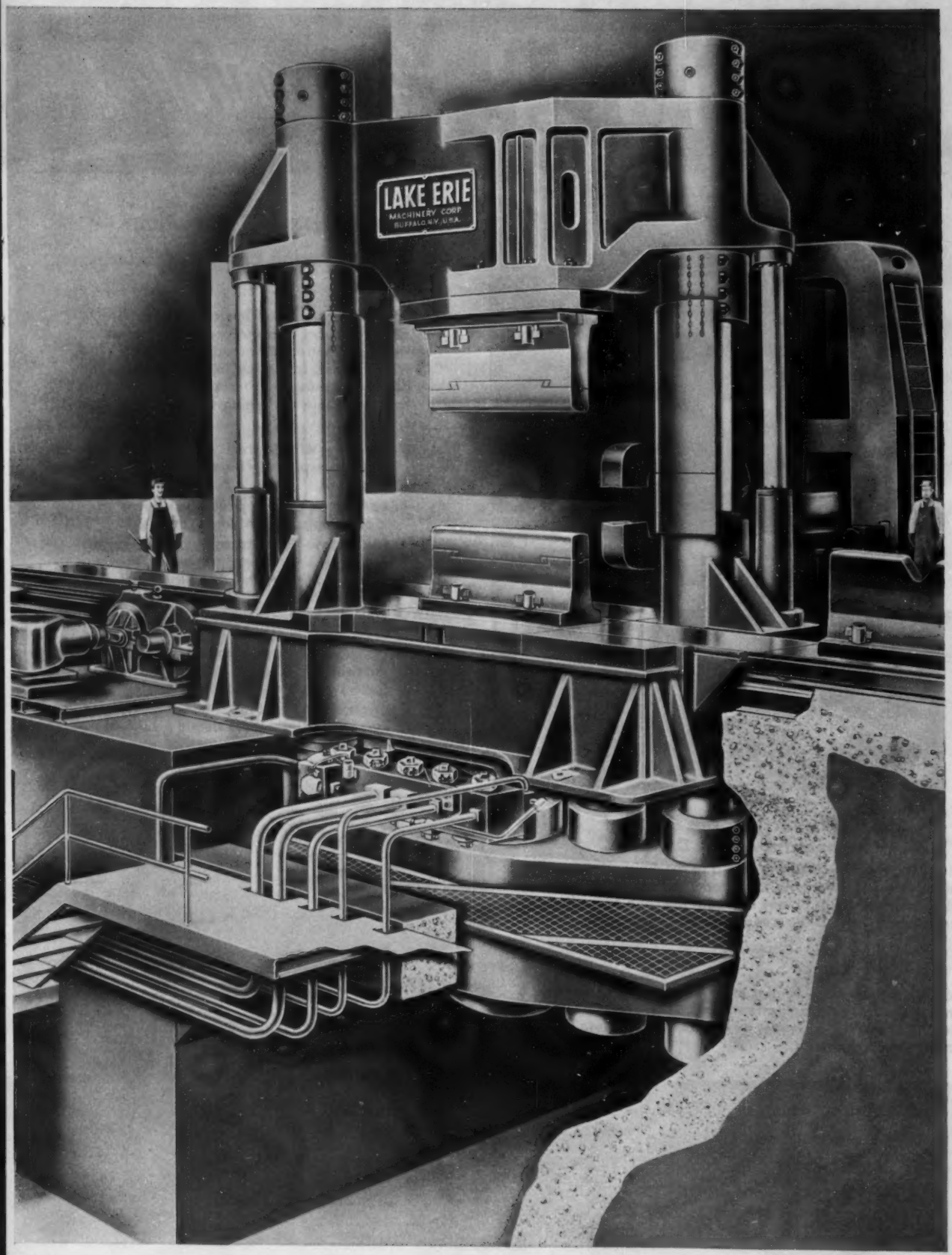
- **A unique 166 foot long 450 ton draw bench with 44 foot stroke —the largest known—for drawing pipe up to 20″ in diameter with 1″ wall thickness.**
- **A self-contained (oil operated) 4300 ton aluminum extrusion press for Reynolds Metals Company.**

FOR ENGINEERING • EXPERIENCE • RESPONSIBILITY **LAKE ERIE**
machinery corporation

BUFFALO
new york



ARTIST CONCEPTION of the unusual 2000 ton Allegheny Ludlum forging press which is currently operating three shifts a day. It is impossible to illustrate this press photographically because it extends through the floor.



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BURGMASTER *tape controlled*

Maximum Flexible Automation---

for Drilling, Boring and Tapping Lots of Any Size

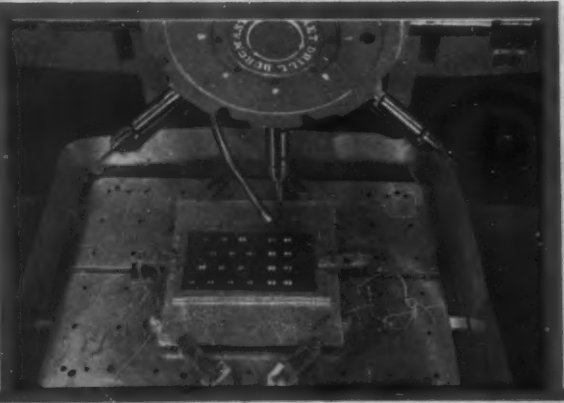
At Rocketdyne, small lots are no limitation in putting a part into automatic production on the tape controlled Burgmaster machine. The fact is, small lots bring into sharp focus the basic advantages of performing all close tolerance hole machining operations by this method.

- **jigs are eliminated and simple standard clamps may be employed to hold the work.**
- **costly tool room procedures for special tooling is greatly minimized.**
- **lead time is reduced since it requires much less time to program a part, prepare the tape, make the setup and get into production.**
- **surer faster production is assured because the Burgmaster follows the tape command signals exactly, and continues machining to close tolerances in the fastest possible manner.**
- **engineering changes are quickly put into production by the simple modification of a tape.**

Speed Production, Cut Costs of Experimental or R & D Parts.

Less time, from the drawing board to the finished part—this is the simple formula that works to your advantage when producing lots of any size with the tape controlled Burgmaster Turret Drilling Machine.

268 operations on 100 holes are produced 8 times faster on this Rocket Instrumentation Panel. During machining, one tool change is made on two spindles. Note the simple holding clamps.



World's Largest Builder of Turret Drilling Machines

"O" Manual
Power Index
¼" Capacity

1C Manual
Power Index
⅜" Capacity

2B Manual
Power Index
¾" Capacity

2BF Flange Mounted
Power Index
¾" Capacity

2BH Automatic
Hydraulic
¾" Capacity

3BH Automatic
Hydraulic
1½" Capacity

2BR Ram Type
Radial Drill
¾" Capacity

2BHT-3BHT Automatic
Tape Controlled
¾" and 1½" Capacity

8 SPINDLE TURRET DRILL

Tool savings alone will pay for a $68,000 Tape Controlled Burgmaster Turret Drilling, Tapping and Boring Machine within a year, while producing small lots from 3 to 5 parts. In addition, the machine is producing up to 8 times more parts compared to conventional machining methods.

Time is the vital element in producing Research and Development hardware and production at Rocketdyne moves fast in order that parts in process will reflect improvements determined by latest tests. The tape controlled Burgmaster is an answer to getting into production fast and making engineering changes rapidly and inexpensively.

Parts are clamped on the 30" x 45" positioning table using an aluminum sub-base and simple clamps instead of expensive tooling with drill bushings. Table positioning is rapid and accurate, being automatically controlled by tape to accurately locate the work on two axis for each setting. The tape also controls the selection of proper spindle sequence and all machine functions. In addition, all standard adjustable Burgmaster controls are maintained including pre-selective spindle speeds, infinitely variable pre-selective feeds, selective rapid approach and return, skip indexing, precision depth control and simple manual controls for making fast set-ups. As a result, all operations are carried out at their most efficient rate for high finish, precision, speed and longest tool life.

INQUIRE TODAY at no obligation how you can save time with Automatic Tape Controlled Production. There is a Burg representative or dealer near you that will supply all the facts.

SEQUENCE OF 268 MACHINING OPERATIONS

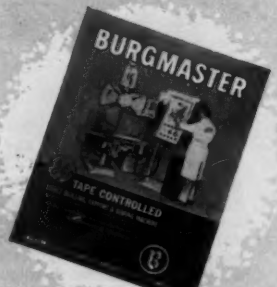
Spindle No.	Tool	No. of Holes	Speed	Feed
1	No. 1 Centerdrill	72	2400	.003
4	No. 4 Centerdrill	28	2400	.003
2	.159 Drill	52	1540	.005
6	Tap 10-32NF-3B Tapmatic Head	52	330	.031
7	.136 Drill	16	2400	.003
3	Tap 8-32NC-3B Tapmatic Head	16	330	.031
5	1.06 Drill	10	490	.003
8	.75 Drill	11	770	.003
1*	.406 Drill	7	1200	.004
4	.218 Drill	4	2400	.004

* NOTE: Tape is programmed to stop machine after drilling eleven .75 Holes with Spindle No. 8. Tools are changed on Spindles No. 1 and No. 4 per above chart, then automatic tape controlled operation is resumed by depressing the start button on the master panel to complete the last 11 holes.

Job Facts

Machine:	Burgmaster 3BHT 8-Spindle Turret Drilling, Tapping and Boring Machine with 30" x 45" Positioning Table and GE Tape Controls.
Company:	Rocketdyne, a Division of North American Aviation, Inc., Canoga Park, California.
Part:	Rocket Instrumentation Panel.
Material:	1020 steel plate, ¼" x 9" x 18".
Operations:	Centerdrill and drill 100 holes, tap 68 holes: a total of 268 operations.
Holding:	Standard clamps.
Quantity:	Five parts.
Accuracy:	Table positioning to ±.001".
Former Method:	Line of single spindle drills using drill jig.
Former Time:	One part per day.
Present Time:	Eight parts per day.
Advantages:	Increased production 8 to 1, lead time drastically reduced, tool saving alone will approximately pay for $68,000.00 Burgmaster Machine within a year.

Write for Bulletin describing Burgmaster 6 and 8 spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. See Burgmaster Machines in action: Thirty-minute 16mm sound film showing all Burgmaster Turret Drills in operation is available from any Burg office without charge.



BURG TOOL

MANUFACTURING COMPANY, INC.

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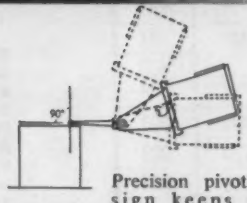
electro→probe.

Yes, the Electro-Probe *does* measure to high accuracies, even with a set-up as limber as this. It's the *only* gage that can!

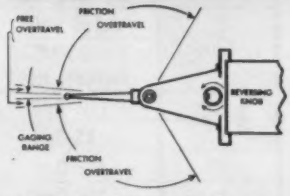
1 By far the lowest contact pressure of any electronic gage . . . only 2.5 grams . . . a precision touch so light that you can gage *dependably, in the shop* without the need for highly rigid, heavy-weight stands. Only with the Electro-Probe do you get high accuracy gaging using an ordinary test set or other *easily* available fixture.

2



Precision pivot design keeps this feather-light pressure virtually constant throughout range to maintain necessary gaging accuracy (change is less than 0.1 gram per .001" of contact travel). This pressure uniformity is found only in the Electro-Probe. AND only in the Electro-Probe is this pivot point properly located so that magnification *remains constant* with changes in gage head position.

3



You can use the Electro-Probe anywhere safely and conveniently. Gage head and cord are impervious to oil and water. Contact can be positioned anywhere within arc of over 200° and is clutch-mounted for complete overtravel protection. Small ball tip on contact lets you check where other electronic gages cannot. Other size tips available.

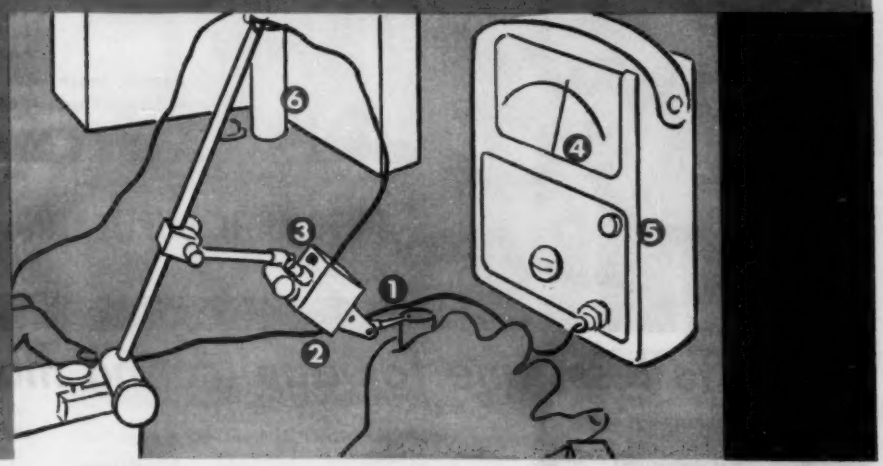
Ask FEDERAL *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

the original and still by far the best low cost, portable, electronic gaging unit

ITS *feather light* TOUCH MAKES THE **BIG** DIFFERENCE

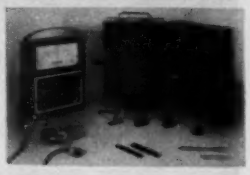


4 Wide view dial has accurately calibrated, clearly marked scales. Pointer is needle thin for precise, unconfused readings. You choose any two magnifications you want from 100 X to 10,000 X. Lowest magnification gives you ± .020″ range and .001″ min. grad.: highest gives ± .0002″ range, .000010″ min. grad. Lightweight amplifier uses high-reliability transistors that outlive vacuum tubes 20 or 30 to 1. Mercury cell batteries provide long life, constant voltage, drift-free operation; give you an *electronic* gage which has *instant* start up. No slow-charge batteries and dangling AC cords to impair its use and portability.

5

Wide range electrical zero adjustment lets you set-up quickly, without the need for close, time-consuming mechanical adjustment of the gage head. For convenience, zero settings and readings coincide on both scales. Printed wiring is rugged and mounted on extra-thick, heavy duty card to give you lifetime dependability.

6



The Electro-Probe is truly a gaging UNIT — comes equipped with holding bars and rods, plus swivel clamp and variety of backs — all you need for mounting the head on available test-set stands and similar fixtures. The gage head, self-powered amplifier and accessories are packaged for portability in one lightweight metal carrying case . . . and the Electro-Probe has the lowest price tag of any comparable instrument, even those that provide only a gage head and amplifier!

Want a demonstration? . . . gladly, at your convenience.

Brochure available, write . . . **FEDERAL PRODUCTS CORP.**

6112 Eddy Street, Providence 1, R. I.

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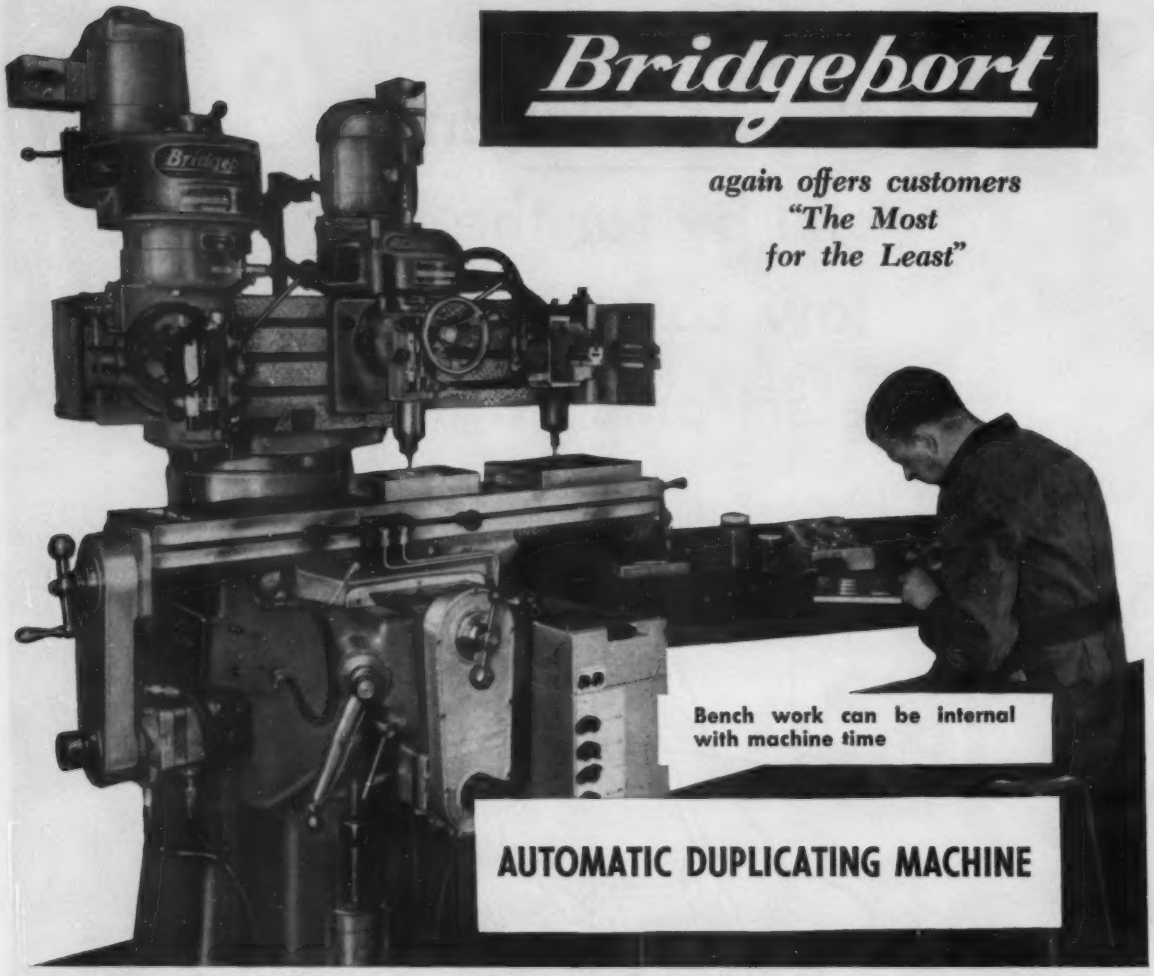
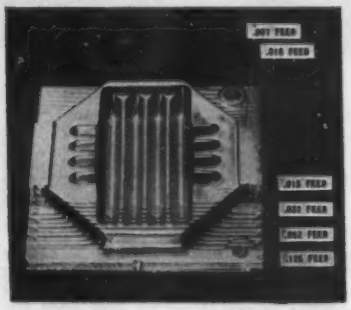
Bridgeport

again offers customers "The Most for the Least"



50% less time for duplicating most parts



Any degree of finish available by simple adjustment of pick feed

Features

Fully automatic . . . variable feed rates . . . push button rapid traverse . . . can be used as standard hand-operated machine . . . uniform cutting feed in any plane . . . pick feed in either direction . . . conventional 180° die sinking for roughing . . . ways and screws chrome plated.

For detailed information contact your nearest dealer or us direct.

Bridgeport MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines

PRODUCTION POINTERS

from **GISHOLT**

MASTERLINE GISHOLT SINCE 1887

How would you thread parts like this? ***By milling? By grinding?***

WATERVLIET THREADS 342% FASTER WITH CRI-DAN

Uses low-cost carbide tools in place of expensive milling cutters and grinding wheels

If you are threading small or medium parts up to 50 Rc hardness, these production figures comparing thread milling and grinding with the Cri-Dan method may be mighty impressive to you:

Breechblock threading production increased from 14 to 48 pieces per day.

Bushing threading production increased from 80-95 to 320 pieces per day.

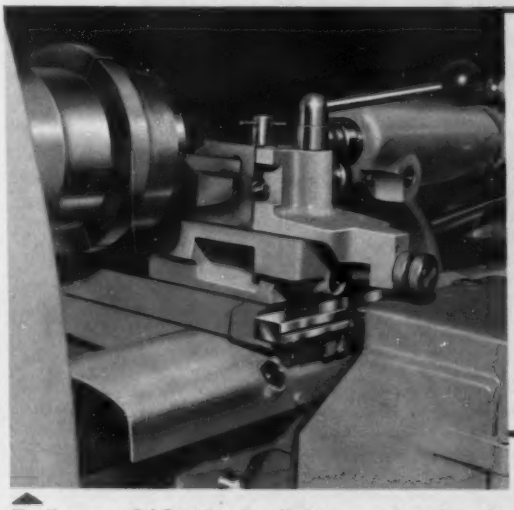
These increases are typical of many now obtained on Cri-Dan Threading Lathes by Watervliet Arsenal, Watervliet, New York.

But production alone is not the full story. Cri-Dan improves quality—gives a smoother finish without scallops or chatter marks. Cri-Dan cuts tooling costs by using inexpensive, single-point carbide tools that are easily sharpened or replaced. Setup on these jobs averages just 15 minutes. Automatic cycle often permits one man to handle two machines with ease.

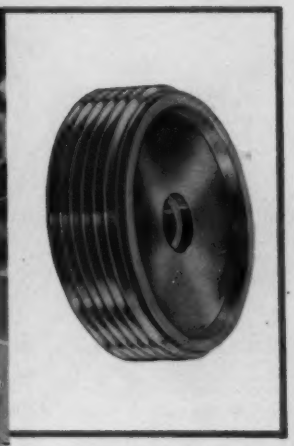
Cri-Dan method simplifies setups, cuts tool and original equipment costs, speeds production. Higher metal removal rates of carbide tools obsolete thread milling and grinding on tough jobs and materials.

Producing four acme threads per inch on this 1″ bushing demonstrates the efficiency of the Cri-Dan B on small parts. Stock, 1120 or 1130 steel; major diameter, 0.832″; pitch diameter, 0.737″. Thread depth, 0.080″. Thread milling production, 80-95 parts per day at 5-6 minutes per part. Cri-Dan production rate, 320 parts per day at 1.5 min. per part. Carbide tool life on the Cri-Dan averages 200 parts.

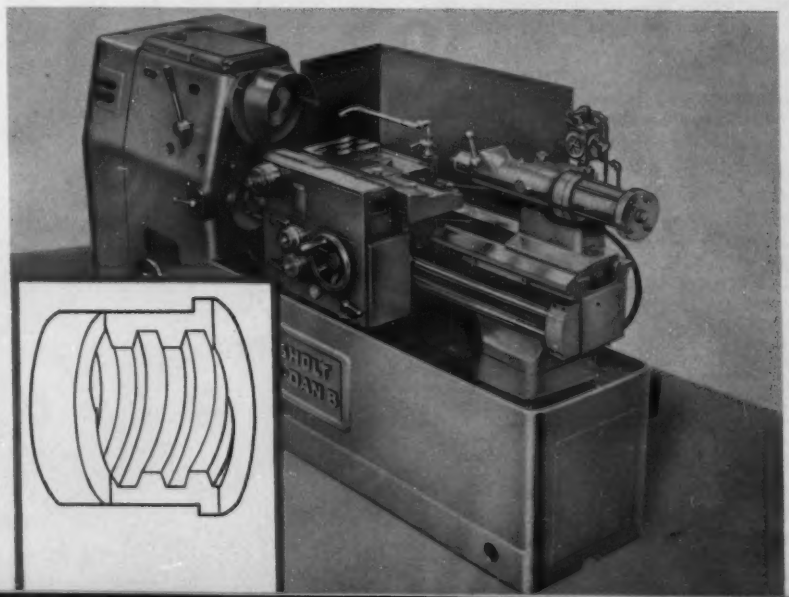
For new Cri-Dan B Catalog, circle No. 701 on Reader Service Card.



Tooling on a Cri-Dan E to handle larger work such as this 8″-diameter breechblock bushing. Standard 8-pitch thread is produced in 35-41 Rc material at a rate of 48 pieces daily, as compared to 13 parts per day by thread grinding.



Cri-Dan E production rate for 6″-diameter breechblocks, 48 pieces each day, compared to 14 pieces per day by thread grinding shows an increase of 342%.



THIOKOL CHEMICAL CORP., REACTION MOTORS DIV., SAVES 75% ON TOUGH ROCKET ENGINE PART

Quick setup and versatility of No. 3 ram cut job-lot costs

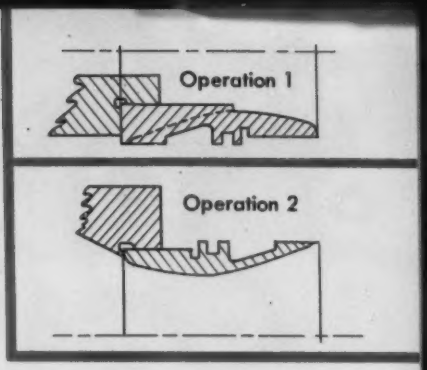
One or more of the three problems listed below probably needs answering in your shop, too.

Finish to 32 micro-inches RMS. Contour to plus 2", minus 0". Machine and tooling versatility to handle other jobs to close tolerances, with minimum change-over time and tooling.

Here's how these problems were answered for Thiokol Chemical Corp's. Reaction Motors Division plant, Bristol, Pennsylvania. The machine: a standard Gisholt MASTERLINE No. 3 Ram Type Turret Lathe. Tooling: standard turret lathe tools; a 10", 3-jaw air chuck; and a special taper attachment.

The part, a copper nozzle for a liquid fuel rocket engine, is completed in two operations. It is held in the bore, locating against the back face. Hexagon turret tools turn straight O.D. surfaces, while square turret tools machine O.D. contours and grooves, and face the end. One half of the bore is rough- and semi-finished in four passes with the rear tool-post, using a taper attachment to generate the contour, F.t.f. time, 12 min. For operation 2, the work is held on the machined O.D., locating against a machined face. Hexagon turret tools finish-turn the O.D. The end is faced from the square turret. The second half of the bore is roughed, and semi-finished in four passes. The entire bore is then finish-generated, using the special taper attachment. Time, 8.5 min., f.t.f.

Special rear tool-post taper attachment generates contour in bore. Air cylinder maintains constant pressure on cam follower for 32 micro-inches RMS finish. (Inset) Finished part at left, first operation at right.



Change-over from operation 1 to 2: new chuck jaws, resetting of tools on hex 5 and taper attachment. Versatility? Nine operations on five different complex parts are performed on this machine, using the same hex turret tooling with only minor tool adjustment or replacement and chuck jaw changes.

Standard machine with minimum special tooling keeps costs down on short runs of complex parts. Accuracy and finish in contoured bore obtained with special cam and taper attachment.

For information on Ram Type Turret Lathes, circle No. 702 on Reader Service Card.

BALANCING AT CATERPILLAR RESEARCH HELPS DESIGN AND PRODUCTION

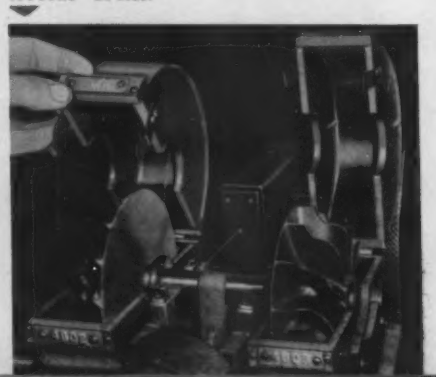
With the trend to smaller, lighter components and higher operating speeds, balancing is an important tool in product development—as well as in production. But to justify its purchase for balancing small research lots, a machine must have the versatility to handle a great range of work sizes and weights. This setup, showing how balancing is used in development work, may give you some new ideas for your own operations.

31S balancer handles wide variety of test parts . . . boosts designing and production planning efficiency

High-speed components were causing vibration problems in the Research Department of Caterpillar Tractor, Peoria, Illinois. Since existing equipment was not capable of solving this problem, a Gisholt 31S Balancer was installed. The 31S was selected for its ability to meet the necessary accuracy requirements—for its versatility in handling a wide range of work economically...and for its fast setup to handle 1- or 2-piece lots.

Because Gisholt balancers use modern, electrical methods to measure amount and indicate angle of unbalance in each correction plane, maximum accuracy is assured and guesswork is eliminated. Two sets of work supports permit balancing of work ranging from 2 to 300 lbs., up to 24" in length and diameter, with shaft diameters at bearing surfaces up to 2⅛" or 5". Setup averages approximately 30 minutes for most parts handled.

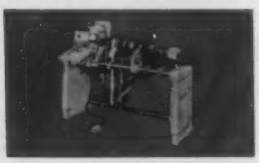
A typical job—a Turbo-Supercharger for a 6-cylinder diesel engine: diameter, 6"; bearing shaft, ¾"; weight, 4 lbs.; operating speed, 50,000 r.p.m. This requires 2-plane balancing with correction on the large-diameter wheels at each end. Unbalance is quickly measured and located. Correction is by grinding. Since this is a test piece, time is not too important, but accuracy is vital. Balancing reduces vibration at bearing surfaces to .000025" or less.



Typical parts handled efficiently in 1- and 2-piece lots. Left to right: fixture for a high-speed coupling which has no bore for shaft support; turbine wheel and shaft; fan pulley; timing gear assembly.

Accurate balancing of prototypes in research permits early decision as to where metal may be removed or added before going into production—saves costly production tie ups—eliminates extra design changes.

For information on Type S Balancers, circle No. 703 on Reader Service Card.



HOW THOMPSON RAMO WOOLDRIDGE INC'S. FEDERAL WORKS SIMPLIFIES GROOVING JOB ON TRANSMISSION PART

Smart tooling speeds machining, automatic cycle doubles operator productivity

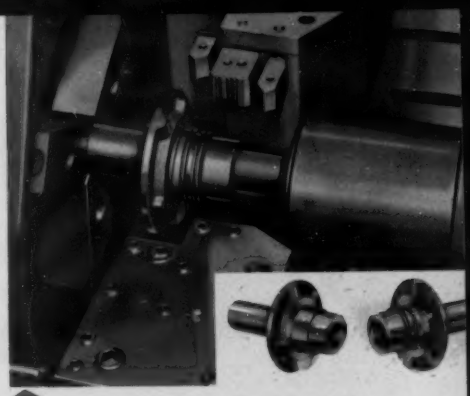
In this setup on two Gisholt MASTERLINE No. 12 Automatic Chucking Lathes, tooling is simple and floor-to-floor time is fast, It shows how a simple tooling change cut costs and machine downtime for Federal Works, Thompson Ramo Wooldridge, Inc., Detroit, Michigan.

The workpiece, a transmission converter support assembly, is held in a 12″, 3-jaw compensating chuck. It is supported between centers for extra rigidity during simultaneous turning and grooving cuts.

The front carriage moves towards center, then feeds towards the spindle. Tools turn three diameters, including the large flange O.D., then move back for tool relief. At the same time, the rear independent slide feeds towards center to form four grooves, chamfer the large flange O.D. edge and the tailstock end of the part. F.t.f. time, just 30 seconds.

Grooving tooling is worth noting. Previously, expensive circular form tools were used. When one cutting edge dulled or broke down, the entire tool had to be replaced or discarded. Now, four separate throw-away inserts are used in a special holder. Approximately 400 parts are produced per cutting edge. When one edge dulls, the insert is quickly reversed, minimizing downtime.

Quick, accurate chucking and automatic cycle permit one operator to handle two identically tooled No. 12s. Throw-away inserts replace expensive form tools–



Work is supported between centers and held in chuck for maximum rigidity during simultaneous turning and grooving. Four throw-away inserts in grooving tool holder are quickly reversed or replaced, permitting more parts per day at less cost.

For complete information on the Gisholt MASTERLINE No. 12, circle No. 704 on inquiry card.

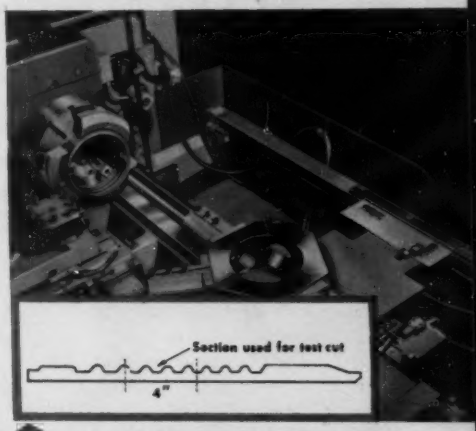
CROSS FEEDING TURRET JETRACER CUTS TOOL COSTS, SAVES TIME

JETracer eliminates costly form tools. Extra cross feed travel minimizes tooling

The flexibility made possible with this tooling setup on a Gisholt MASTERLINE 3L Saddle Type Turret Lathe may give you some new ideas. An oil well component manufacturer is using it to save time and tooling costs on a wide variety of jobs. Work includes straight and taper boring and threading, and contour machining in addition to conventional turret lathe assignments.

The basic tooling to handle the range and type of work described, is as follows: cross feeding hexagon turret with JETracer control and cross travel of 6″ to rear of center and 9″ to front of center allowing one boring bar to handle a diameter variation of 12″; dial indicators to speed setup for both motions of the hex turret; a compound cross slide, with power angular feed and a quick indexing tool post plus a taper and a chasing attachment for internal and external threading operations.

Here's how the tooling works on a typical job, a centrifugally cast steel cement coupling collar, 21¾″ long, 14⅜″ diameter. The work is held in a 21″ 3-jaw scroll chuck. Wide swivel jaws minimize distortion. The end is faced from the square turret. The work is turned and bored from the hex turret. The grooves in the bore (previously handled by form tools) are then rough- and finish-traced from the JETracer controlled cross feeding hex turret. The front end of the bore is threaded for a depth of 5″ from the compound cross slide to complete the operation. Rough casting weight is reduced almost 50% and required accuracy and finish are easily met in a f.t.f. time of only 105 minutes.



JETracer controlled cross feeding hexagon turret eliminates costly form tools, reduces downtime, tool maintenance costs and eliminates human element in spacing of grooves in bores of cement coupling collars. (Inset) Drawing shows part and 4″ section used for test cut shown in photo.

Stop block, attached to template and gage block, is used with dial indicator to establish exact relationship between JETracer stylus and cutting tool with relation to each other and to work.

Capacity of Gisholt 3L plus JETracer, compound slide, taper and chasing attachments permit handling wide range of work economically. Tracing eliminates expensive form tools. Extra cross travel of hex turret minimizes changeover and tooling costs.

For information on Saddle Type Turret Lathes, circle No. 705 on Reader Service Card.

GISHOLT

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

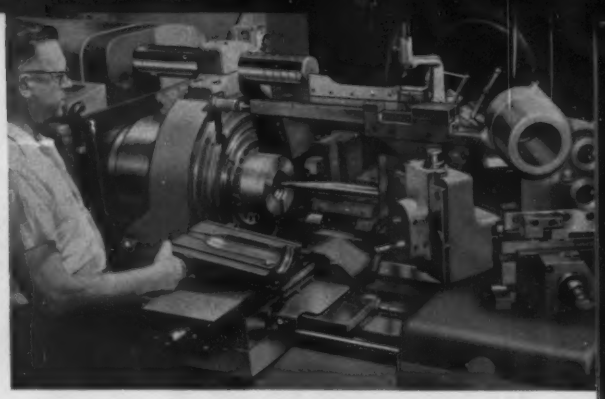
OVERMYER MOULD MACHINES COMPLEX BORES 250% FASTER—AUTOMATICALLY

Simple turret-mounted JETracer slide tool plus automatic cycle speeds machining, improves accuracy and finish

With the setup shown here, you don't need expensive form tools, cams or complex setups to produce difficult contours—for example, the bores of the bottle moulds shown at right. All they use for jobs such as these at Overmyer Mould Company, Winchester, Indiana, is a simple JETracer slide, mounted on the turret of a Gisholt 2F FASTERMATIC Automatic Chucking Turret Lathe. A simple setup, yet it allows Overmyer to handle a great variety of complex shapes and sizes—from 12-oz. bottles to gallon containers—small lots to large.

On the 12-oz. wine bottle mould setup shown, Overmyer saves 250% in setup and production time, and cuts tooling costs substantially. And the finish they get (45 micro-inches RMS) reduces polishing 70%!

The mould, in two mating sections, is held in a special, parallel closing-type collet chuck. A steady rest supports the outer end. The mould is faced to size and an O.D. radius is formed from the rear cross slide. The bore is roughed from the hex turret. Turret slide tools operated by a pusher on the rear cross slide groove and form a 20° angle on the plug seat area. The JETracer slide tool completes the internal contour. Reverse JETracer feed cleans up to the desired accuracy and finish. F.t.f. times range from 20 minutes on this job to 25 minutes for the gallon-jug moulds.



JETracer slide tool mounts on any turret face...does not interfere with other turret stations. Simple, inexpensive setup handles difficult bottle-mould contours in a single pass...holds .002" tolerance in bores up to 6½" in diameter, up to 12" deep.

Typical bottle moulds and templates showing complex contours and fine finish obtained with automatic JETracing as part of automatic machine cycle.

Automatic JETracing allowed by flexible FASTERMATIC handles complex contours... eliminates expensive cams and form tools... speeds production...boosts quality.

For Fastermatic Catalog, circle No. 706 on Reader Service Card.

BUICK DIV. OF GMC SUPERFINISHES TO IMPROVE QUALITY

Process minimizes wear, provides wide range of "controlled" surface finishes at minimum cost

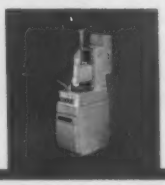
Want to stop paying premium prices for low micro-inch surface finishes and obtain improved quality and longer service life as well? Then investigate Superfinish—the low-cost way to get any "controlled" surface finish on job lots or production runs.

This process proves itself every day in plants all over the world—for example, at Buick Division of General Motors Corporation, Flint, Michigan, Here 45 Superfinishers are used on more than 55 different parts for Buick's twin-turbine automatic transmission, and on other automotive parts as well.

"Controlled" finishes ranging from 2 to 51 micro-inches RMS are produced on external, internal, round, flat, solid and interrupted surfaces. The operator simply loads, starts the automatic cycle, and unloads. Stone pressure, grade, reciprocation rate and spindle speed are preselected to produce the desired finish on each job—automatically, piece after piece.

In most cases work is rough-ground, then Superfinished, eliminating finish-grinding. On some jobs all grinding is eliminated, as on the pump face of the flange-and-bushing assembly for converter reaction shafts, shown.

Superfinishing directly from machined surface eliminates intermediate grinding...provides desired surface finish of 8 micro-inches RMS in minimum time, at less cost. Process is easily applied to all types of surfaces for comparable savings.



The interrupted pump face surfaces on flange-and-bushing assemblies for converter reaction shafts are Superfinished on this Model 81 single-spindle vertical Superfinisher. Cup-shaped stone removes up to 0.001" stock left after finish-facing in 32-second finishing cycle and maintains flatness within 0.0002" while producing an 8 micro-inch RMS surface finish.

An 8-page reprint covering other setups at Buick Division of General Motors Corporation, will be sent on request. Circle No. 707 on Reader Service Card.

No. 1-260
755

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

Printed in U.S.A.

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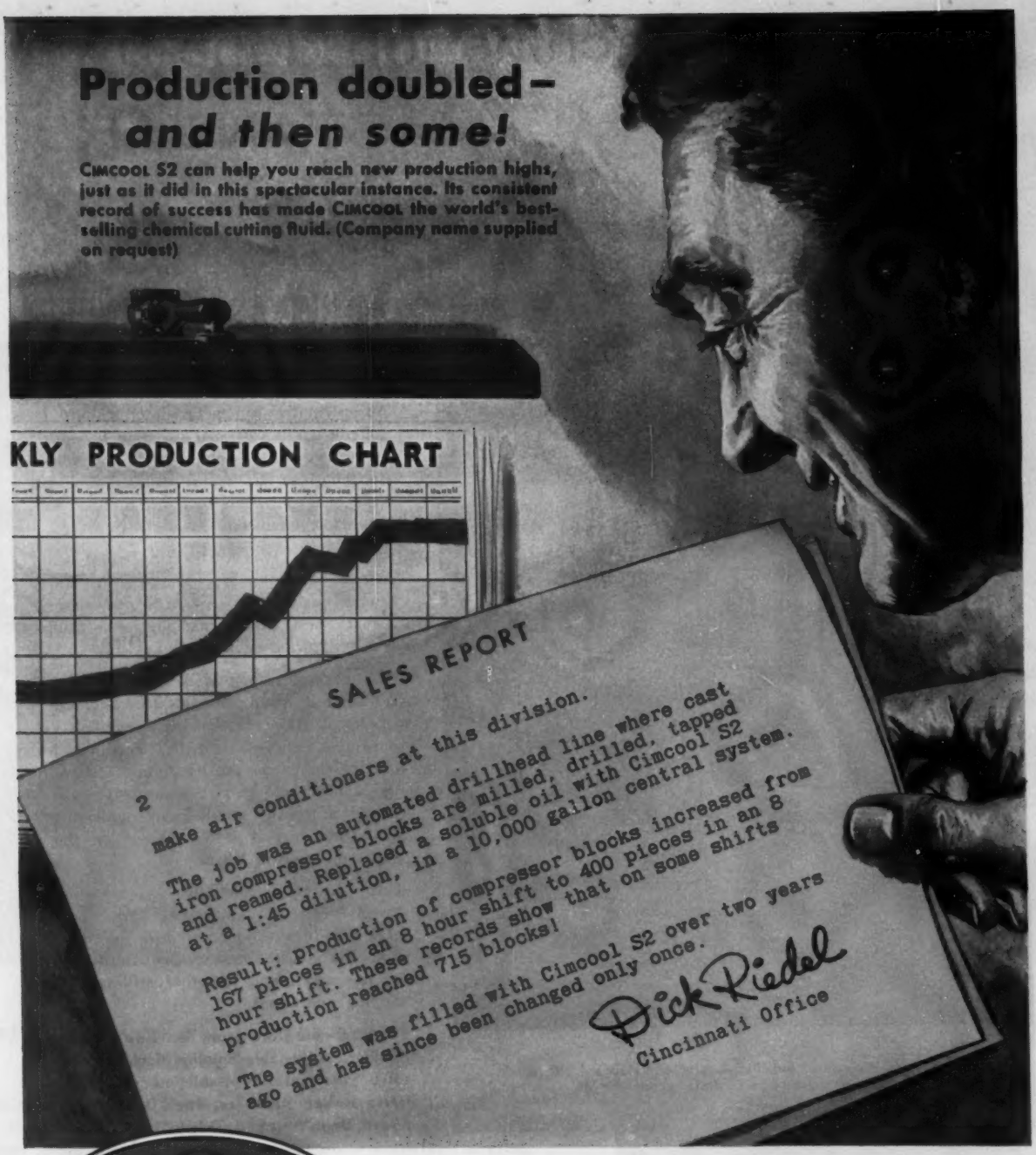
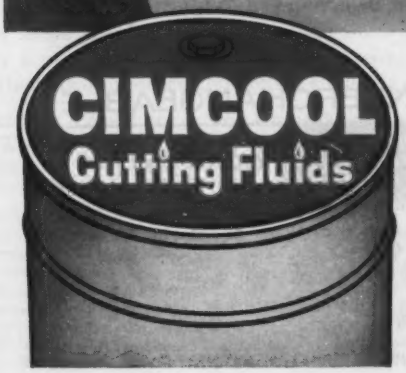
Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products

Production doubled— *and then some!*

CIMCOOL S2 can help you reach new production highs, just as it did in this spectacular instance. Its consistent record of success has made CIMCOOL the world's best-selling chemical cutting fluid. (Company name supplied on request)


KLY PRODUCTION CHART
SALES REPORT
2
make air conditioners at this division.
The job was an automated drillhead line where cast iron compressor blocks are milled, drilled, tapped and reamed. Replaced a soluble oil with Cimcool S2 at a 1:45 dilution, in a 10,000 gallon central system.
Result: production of compressor blocks increased from 167 pieces in an 8 hour shift to 400 pieces in an 8 hour shift. These records show that on some shifts production reached 715 blocks!
The system was filled with Cimcool S2 over two years ago and has since been changed only once.
Dick Riedel
Cincinnati Office



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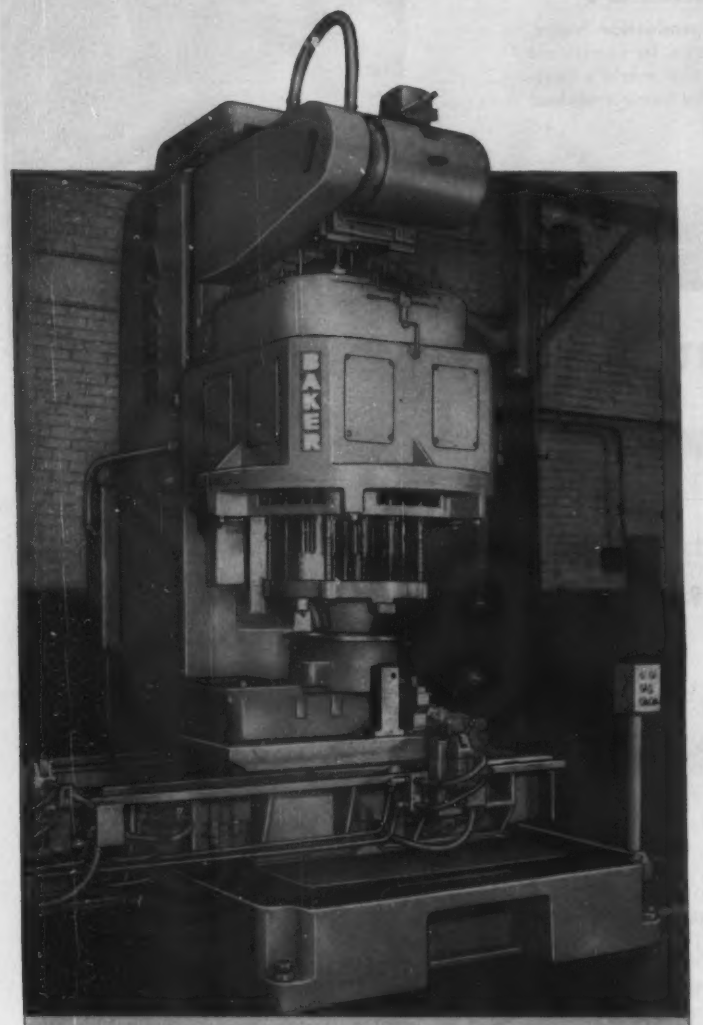
A special machine job done by a STANDARD BAKER®



Baker A-24-VU Adjustable Spindle Machine with standard 36" round universal head and standard slip plate bored for 46 spindles.

ADJUSTABLE SPINDLE MACHINE

An automotive contractor's production did not allow for a special machine to work on heavy, hard-to-handle truck transmission housings. Conscious also of retooling costs, the contractor took his problem to the BAKER engineers.

THE RESULT: This A-24-VU Standard Adjustable Spindle Machine, with a few special adaptations. Only accessories added: slip plate, bushing plate and transfer, including pallet.

The work piece is held on a pallet which transfers it from prior operations where the top flange of the housing is completely machined. The BAKER drills 2 sets of bolt circle holes on the top flange and 1 set at the housing bottom. A bushing plate, supported on the slip spindle plate, guides the drills and targets into bushings on the pallet for positive location.

Using this BAKER Standard, the contractor saved special machine costs, gained the high production needed and found it simple to take the BAKER out of the transfer line and use it for other drilling and tapping operations.

For the complete story on how Baker Standard Adjustable Spindle Machines can solve your special production problems, write Baker Brothers, Inc., 1000 Post Street, Dept. MH-260, Toledo 10, Ohio.

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Battery of presses proves speed and dependability and saves on dies

Johnson Machine and Press Corporation selected Wichita clutches for the Model 4½ press shown above, one of a line installed at Fisher Industries, Inc., serving the automotive industry. The press shown above is one of two Johnson Presses rated at 330 strokes per minute that produced 200 million moulding clips in 18 months.

If you have a clutching or braking problem it will pay you to call in a Wichita Engineer to help you work out a profitable solution.

Contact your nearest Wichita Engineer!

Clutch & Control Engineering Co., Livonia, Mich.
L. H. Fremont, Cincinnati, Ohio
W. G. Kerr Company, Pittsburgh, Pa.
Smith-Keser & Co., Avon, Conn., Philadelphia 44, Pa., and New York, N. Y.
Frank W. Yarline Co., Chicago, Illinois
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Andrew T. Lobel, Denver, Colorado
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Allied Transmission Equipment Co., Kansas City 8, Missouri
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Extra manufacturing care is the ingredient that produces the exceptional accuracy and long life common to all Winter Balanced Action taps. Constantly increasing sales attest the ever-widening acceptance and popularity of these outstanding tools. You owe it to yourself to begin enjoying the benefits and savings that can be yours with Winter Balanced Action Multi Taps. Specify them next time you buy.

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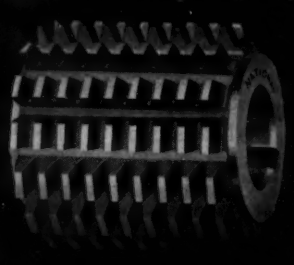
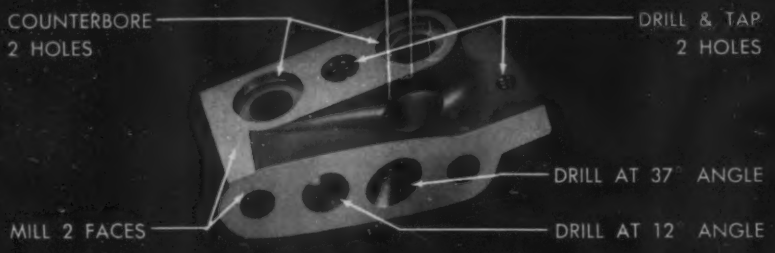


10-spindle Kingsbury combines milling with other operations



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Two units each mill one face with a finish better than 80 micro. Both units are at the operator's left — one vertical and one horizontal.

On the right are five units — angular, vertical and horizontal. They operate on four holes — drill, counterbore and tap.

Production is 360 parts per hour gross. Seven duplicate work fixtures (on a 30-inch index table) make possible operations on six parts while the operator changes parts at the loading station.

All this is on a base 96 inches in diameter. This saves floor space.

Oil mist lubricates the milling and multi-spindle heads.

The customer returned his base, index unit and operating units to us for retooling. That was a real saving. And he has the Kingsbury assurance of good basic design, rugged, accurate construction, and test runs before shipment.

For high production at low cost, ask to have our representative call and talk over your jobs. Let him get you a specific proposal. Kingsbury Machine Tool Corp., Keene, New Hampshire.

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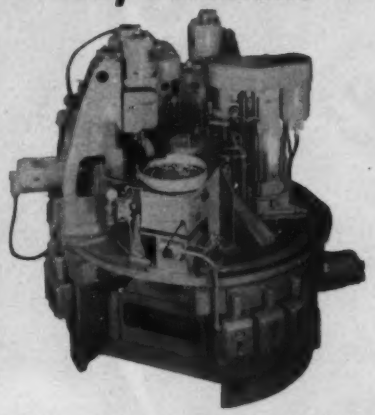
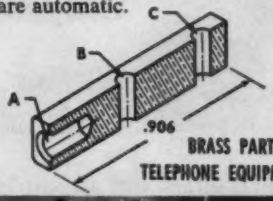
MULTI-UNIT AUTOMATICS

High production in minimum space — fully automatic



Gross production for this 8-spindle Kingsbury is 1,400 parts per hour for drilling the three holes, countersinking A and burring B and C top and bottom. Parts are fed from the hopper via a chute to an air-operated loading mechanism. Clamping, unclamping and ejection are automatic.



BRASS PART FOR TELEPHONE EQUIPMENT

1,000,000 cycles a year for 30 years with no serviceman

In November, 1929 Shakespeare Co. of Kalamazoo, Mich. set up this Kingsbury with their fixtures. It drills five holes and reams two in a part used in never had to call a serviceman on it. We have run it for thirty years — about a million cycles a year — and it still gives us almost no trouble."

POSITIVE DUPLICATION – EVERY TIME!

These highly accurate apothecary weights give *exact* results, time after time after time. You will get this same kind of Positive Duplication with these center-type grinding wheels, and with *all* CINCINNATI PD° GRINDING WHEELS.

HOW POSITIVE DUPLICATION IS ACHIEVED

The predictable performance of these wheels is the positive result of Cincinnati's unique PD manufacturing process. It involves 36 separate quality controls which produce grinding wheels of unsurpassed uniformity. For example, sensitive print-weigh scales put an unmistakable record on each mix card of the exact amounts of materials used. And the figures *must* correspond to the exact amounts called for.

UNIFORMITY HELPS YOU

When you use CINCINNATI PD WHEELS you can plan production schedules with the assurance that each reorder wheel will act and grind exactly like the original. This is the promise—and *performance*—of Positive Duplication.

CALL CINCINNATI TODAY

Solve your grinding problems with the help of Cincinnati's factory-trained specialists. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI PD GRINDING WHEEL Distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

PD POSITIVE DUPLICATION

CINCINNATI° GRINDING WHEELS

°Trade Mark Reg. U. S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

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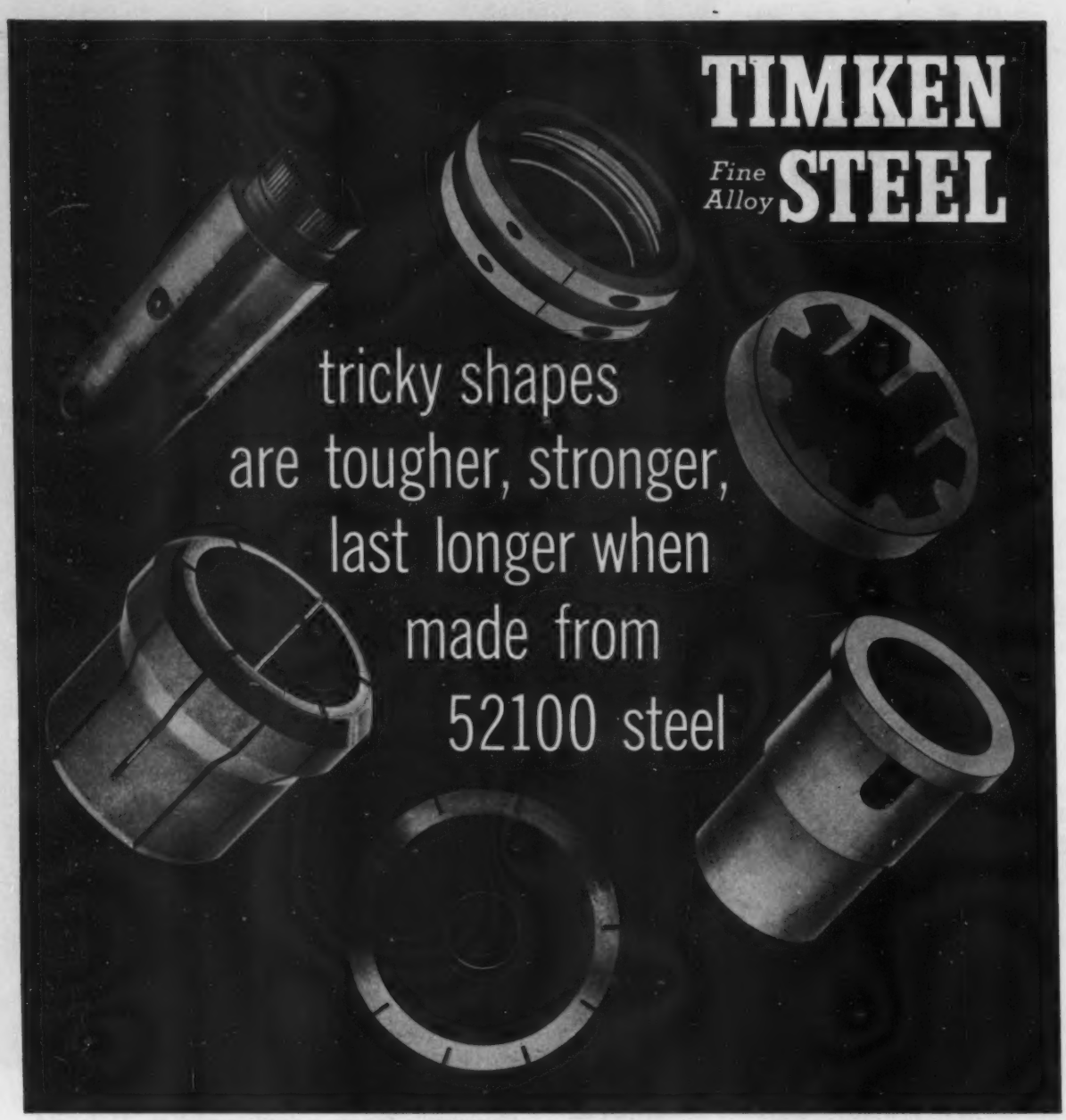
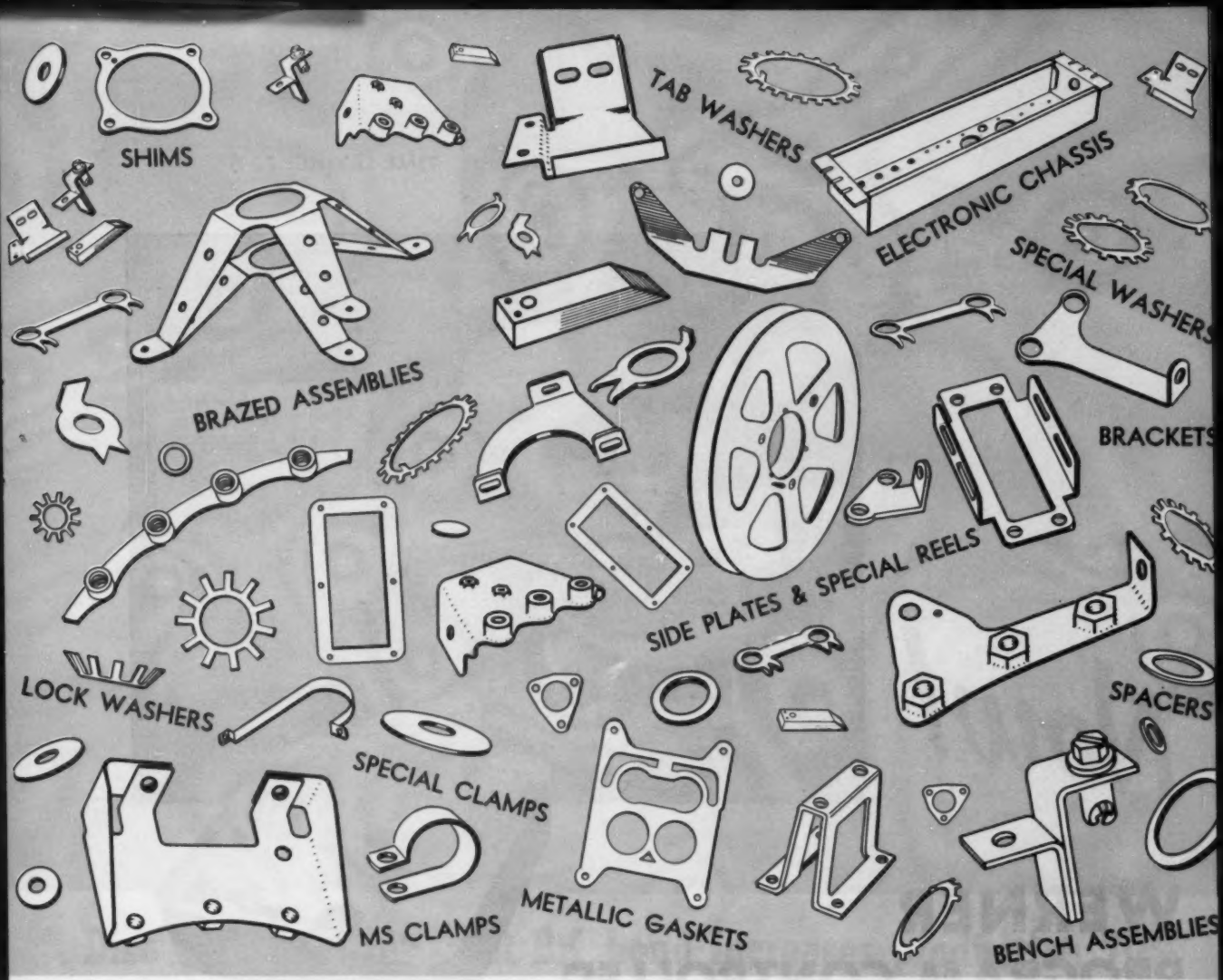


IF you make tricky-shaped parts, like those above, you can make them tougher and stronger with Timken® 52100 steel. Its fully spheroidized structure makes 52100 easy to machine. Yet it retains full strength and hardenability.

Timken 52100 steel is a high-carbon alloy steel with high fatigue and tensile strength. It has good hardenability throughout its cross section, withstands working pressures up to 200,000 p.s.i. easily. It will oil quench to a maximum hardness of 65/66 Rockwell C in normal sections.

And you can be sure of uniformity from order to order with Timken 52100 steel. That's because of the Timken Company's rigid quality control, from melt shop through final inspection. Pioneers in producing 52100 tubing in the U. S., we are the country's only source of this steel in all three common forms: tubing, bar and wire—one of the world's largest producers of this versatile alloy.

For your small run or emergency requirements, we maintain a mill stock of 52100 tubing in 101 sizes from 1" to 10½" O.D. We'll ship your order within 24 hours of receiving it. Send for complete stock list of available sizes, grades and finishes. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*



You name it . . . we'll stamp it
one or a million @ minimum cost

You'll get better service on Stampings from THE LAMINATED SHIM COMPANY. This is literally true because (a) we've been doing it since 1913, and (b) we've perfected our own special equipment, toolings and techniques—all unknown to the ordinary stampings shop. Therefore you get *exactly* what you want, including the degree of precision you need—any contour, often without dies—any size—any quantity—fast, and at a surprisingly low cost—according to our

1 **"ONE PLUS" METHOD**

Applies when you need just a few pieces for prototypes or experiment. We hold all critical dimensions, yet avoid tooling charges.

2 **SHORT RUN METHOD**

More than "a few," but less than production quantities. Temporary tooling, simple dies and special presses keep costs down.

3 **PRODUCTION RUN METHOD**

Applies when quantity, tolerance, size and contour factors justify our standard production tooling and/or nominal die charges.

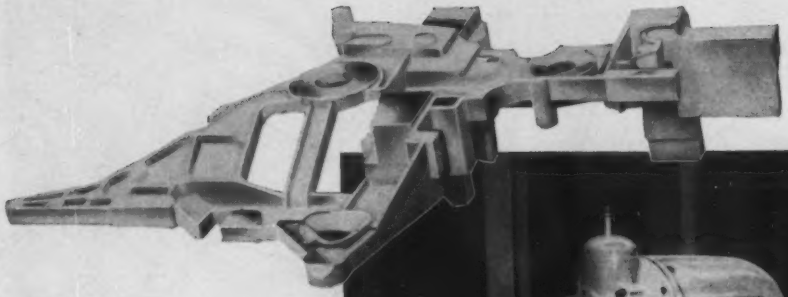
4 **"WATCH DOG" SERVICE**

A routine procedure. We re-evaluate repeat orders as to quantity and specs—then use the Method best for you.

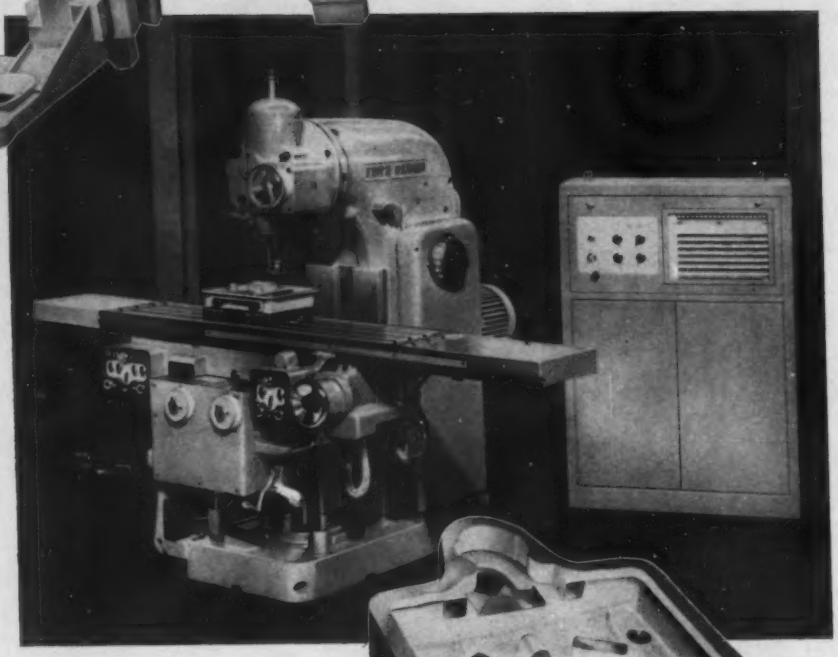
Result: lowest possible cost per unit, regardless of quantity. Want more details? And suggestions for ordering Stampings economically? Send for STAMPINGS Folder No. 3—a most helpful reference booklet.

Stampings DIVISION • THE LAMINATED SHIM COMPANY, INC.

3902 UNION STREET, GLENBROOK, CONNECTICUT



TIME SAVING: 70%



Now!

WERNER PROGRAM-CONTROLLED 3-DIMENSIONAL AUTOMATIC MILLING

TIME SAVING: 44%

Applicable to all new type Werner vertical and plain millers, sizes 1 through 6) (table sizes: 43" x 12" to 102" x 24")

For full particulars and information send your inquiries and blueprints to:

TIME SAVING: 72%

MARAC MACHINERY CORPORATION

108 Grand Street, White Plains, N. Y.

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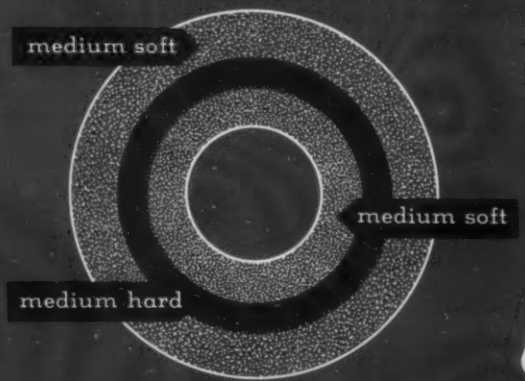
208 OC

Disc with heat resistant BK bond increases production 70%

Grinds over 70,000 washing machine gear cases per disc

Three-grade disc with heat resistant BK bond retains flatness, needs fewer dressings



grinding costs cut 1/3 to 1/2

- longer disc life
- elimination of work burn and warping
- fewer dressings—higher output

GARDNER

abrasive discs

BELOIT, WISCONSIN

T. R. DREYER, Vice President—Brooklyn Manufacturing
American Machine & Foundry Company

a man who came to Fair Street

"The JIGMIL Technique enabled us to establish new manufacturing methods which provided greater accuracy, improvement in our product, substantial reductions in assembly time, and major reductions in machine time, all without investment in jigs."

"We accepted an invitation to go to Fair Street and there saw the JIGMIL Technique in operation doing boring and milling to high degrees of accuracy and economy. The potential savings in our own plant became apparent and we developed a JIGMIL program which resulted in new economies in our manufacturing methods. The inherent accuracy, power and rigidity of this machine tool, combined with its automatic positioning and ease of operation are especially adaptable to precision boring and milling operations on side frames and gear boxes. In addition to the noteworthy savings in boring time and reduced tooling cost, we gained the advantage of milling in the same setting at a minimum of cost."

T. R. DREYER

DE VLIEG MACHINE COMPANY, FAIR STREET, ROYAL OAK, MICHIGAN

SOME OF OUR JIGMIL USERS

Aerojet-General Corp.
American Can Co.
Avco Manufacturing Corp.
Baldwin-Lima-Hamilton Corp.
Beech Aircraft Corp.
Boeing Airplane Co.
Boyar-Schultz Corp.
Carrier Corp.
Clark Equipment Co.
Continental Can Co., Inc.
Convair, A Division of General Dynamics Corp.
Crankshaft Machine Co.
The DeLaval Separator Co.
Detroit Broach Co.
Douglas Aircraft Co., Inc.
Eastman Kodak Co.
Emsco Manufacturing Co.
The Falk Corp.
Foote-Burt Co.
Goss Printing Press Co.
Grumann Aircraft Engineering Corp.
Hamilton Ltd., Division, United Aircraft Corp.
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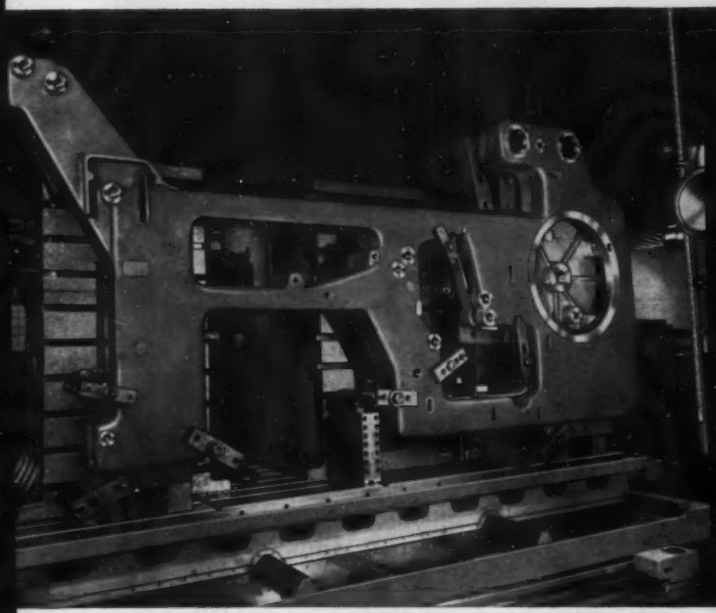
Illinois Tool Works
Ingersoll-Rand Co.
LeTourneau-Westinghouse Co.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE—

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

A TYPICAL EXAMPLE OF JIGMIL VERSATILITY

AMF uses the JIGMIL Technique for machining a multitude of components for their cigarette making machines, bread-wrapping machines, automatic pin setters, cigar making machines and many others. Illustrated is a pair of bread-wrapper side frames set against angle blocks on a Model 4B-96 SPIRAMATIC JIGMIL. All boring and side milling operations were done on the JIGMIL in one setup. Previous time on conventional boring and milling machines was 10 hours per part. Time on the JIGMIL is 3 hours per part.

The Glenn L. Martin Co.
Michigan Tool Co.
North American Aviation, Inc.
Northrop Aircraft, Inc.
Otis Elevator Co.
Pratt & Whitney Aircraft Division, United Aircraft Corp.
Solar Aircraft Co.
Speco Division, Kelsey-Hayes Co.
Thompson Products, Inc.
United Shoe Machinery Corp.
Western Electric Co., Inc.
Yale and Towne Manufacturing Co.
York Corp.

WILL YOU BE THE NEXT TO VISIT FAIR STREET

Model 4B-96 SPIRAMATIC JIGMIL as used by American Machine & Foundry Co.

For complete information on DeVlieg Spiramatic Jigmils, send for new catalog.

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

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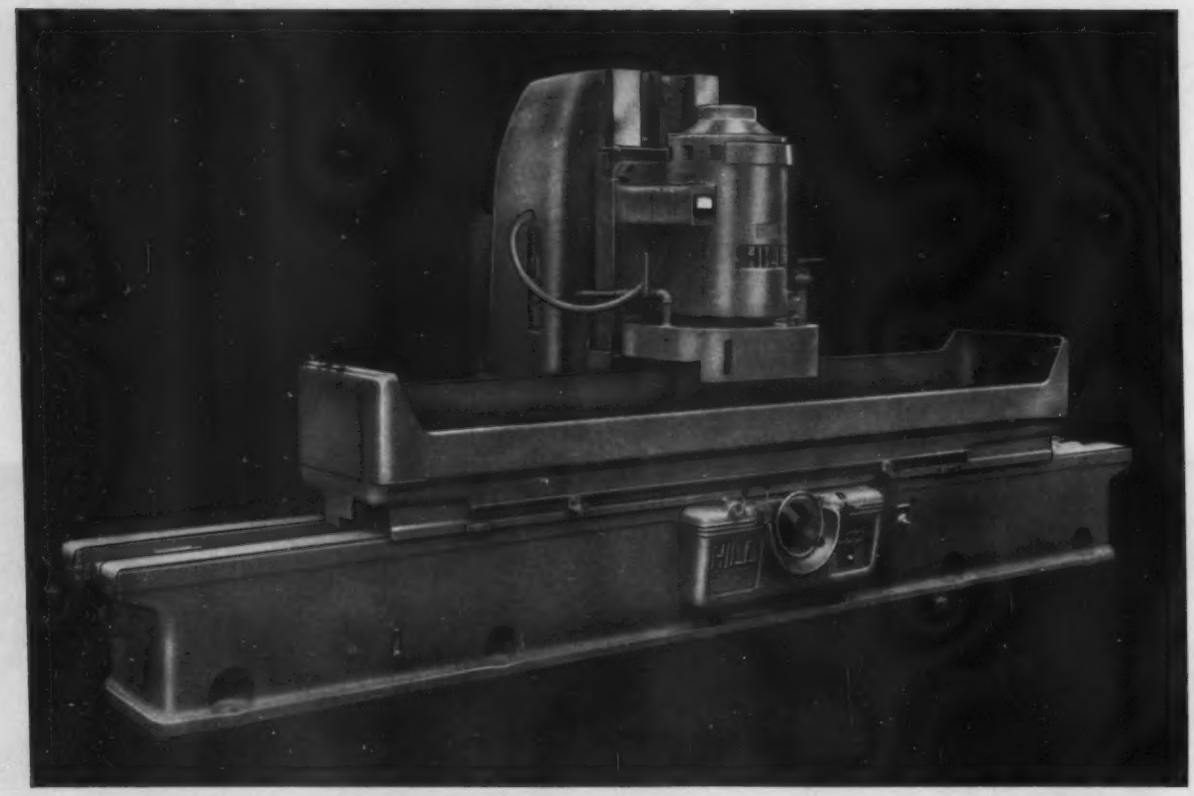
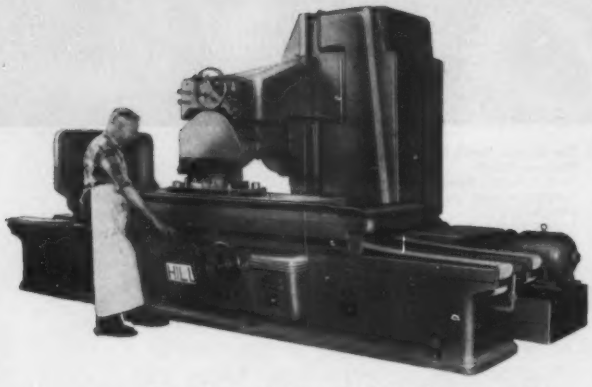


Hill Grinder ELIMINATES MILLING OPERATION



For grinding to extremely close tolerances on flats, angles, irregular and special shaped surfaces the HILL Horizontal Spindle grinder is recommended.

Expensive, time consuming milling operations can be eliminated in finishing die blocks, bolster plates etc. with the new HILL Vertical Spindle Hydraulic Surface Grinder. Equipped with either 75 or 100 HP main spindle motor, the segmented grinding wheel provides fast stock removal and produces an accurate finish in approximately half the time required for a combined milling and grinding operation.

The HILL fully hydraulic reciprocating table is adaptable to a wide variety of stock sizes having flat surfaces. Table widths are 18″, 24″ and 30″ with table lengths from 5 to 20 feet.

The HILL ACME Company

1201 WEST 65th STREET, CLEVELAND 2, OHIO

Also manufacturers of: HILL GRINDING AND POLISHING MACHINES • "ACME" FORGING MACHINES • ROTARY SCRAP SHEARS • ALLIGATOR SHEARS • "CLEVELAND" KNIVES AND SHEAR BLADES • MATERIAL HANDLING EQUIPMENT • BAR-BILLET SHEARS

This shop cuts costs by using STANICUT *Oil 137 BCS*

Machines seven metals, one plastic with this one cutting fluid

Shank Manufacturing Company, Chicago, cuts production costs three ways by using STANICUT Oil 137 BCS. (1) The 15 Warner & Swasey Lathes are never down for change of cutting fluid when the metal being worked is changed. There's no time lost with shutting down, cleaning up and changing oil. (2) There are no losses from the use of the wrong cutting fluid. (3) Floor space is used for productive machinery instead of being tied up as storage space for barrels of different cutting fluids.

Titanium, brass, alloy steel, aluminum and seven grades of Stainless plus Teflon plastic are all worked on the machines. Latest equipment, a reputation for good work, experienced operators and on-time delivery keep business coming to Shank. STANICUT Oil 137 BCS helps Shank hold down manufacturing costs.

Does cutting costs with a cutting fluid interest you? Let one of Standard Oil's experienced lubrication specialists show you how STANICUT Oil 137 BCS can do it. Call the Standard Oil office nearest you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

Frank Kruppe, Shank president (left) shows Hank Krueger of Standard Oil one of the pieces Shank Mfg. produces. Hank Krueger provides Shank plant with technical service on cutting fluids. Hank has the experience for this work. He's been doing it for six years. He has an engineering degree from Illinois Institute of Technology and has completed Standard's Sales Engineering School.

Compare the Production
of these two
DoALL BAND MACHINES

1952 MODEL V36 MACHINE

Obsolete fixed table machines were terrific in their day, using carbon steel blades and manual feed to cut mild steel at a rate of 1.7 sq. in./min.

1960 CONTOUR-MATIC* MACHINE

. . . has hydraulically-powered work table and Demon* H.S.S. saw blade to cut mild steel at 10.1 sq. in./min.

They Look Alike...But *LOOK* at the *DIFFERENCE!*

You'll be amazed at the increased cutting rates, accuracy and finish achieved by new Contour-matic band machines. Here's a typical case:

CONTRACT JOB—splitting high-chrome, high carbon tool steel bushings 13½" O.D. x 8½" I.D. by 31" long. It took 8 hours to split a bushing on the fixed table Model V 36 using carbon steel blade.

FLOOR TO FLOOR TIME CUT 75%—Now the job is put on the power feeding table of a Contour-matic which uses Demon H.S.S. saw blades to split a bushing in just 2 hours. This splitting becomes semiautomatic with accuracy and finish greatly improved. And the tool life is 30 times longer than carbon steel blades.

Yes, there are literally hundreds of other applications where the new Contour-matic can make similar savings over fixed table saws and more expensive machines you are using for shaping cuts, recessing, beveling or cutting contours in the toughest steels. Investigate now to replace obsolete machines that can't keep up with the competitive race for lower costs. Call your local DoALL store for a free demonstration—right in your own plant—or write.

FREE—"Job Spotting" Service

For your evaluation—illustrated case histories of job savings made by Contour-matics over former methods will be mailed to you periodically. Send us your name on company letterhead.

B-57

*Reg. T. M. The DoALL Company

THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

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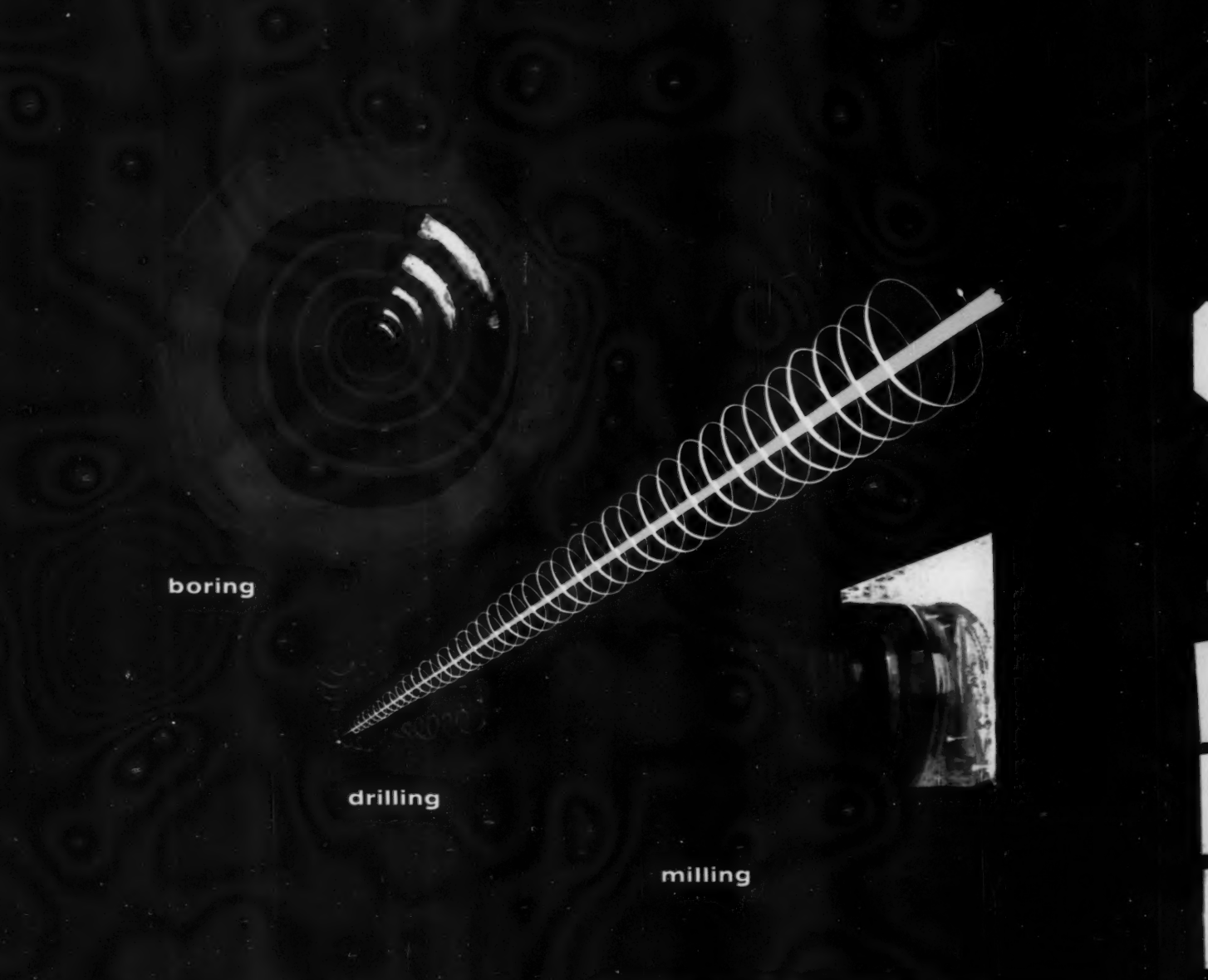
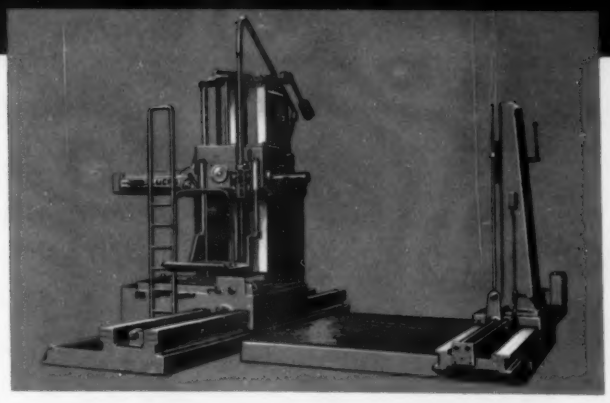
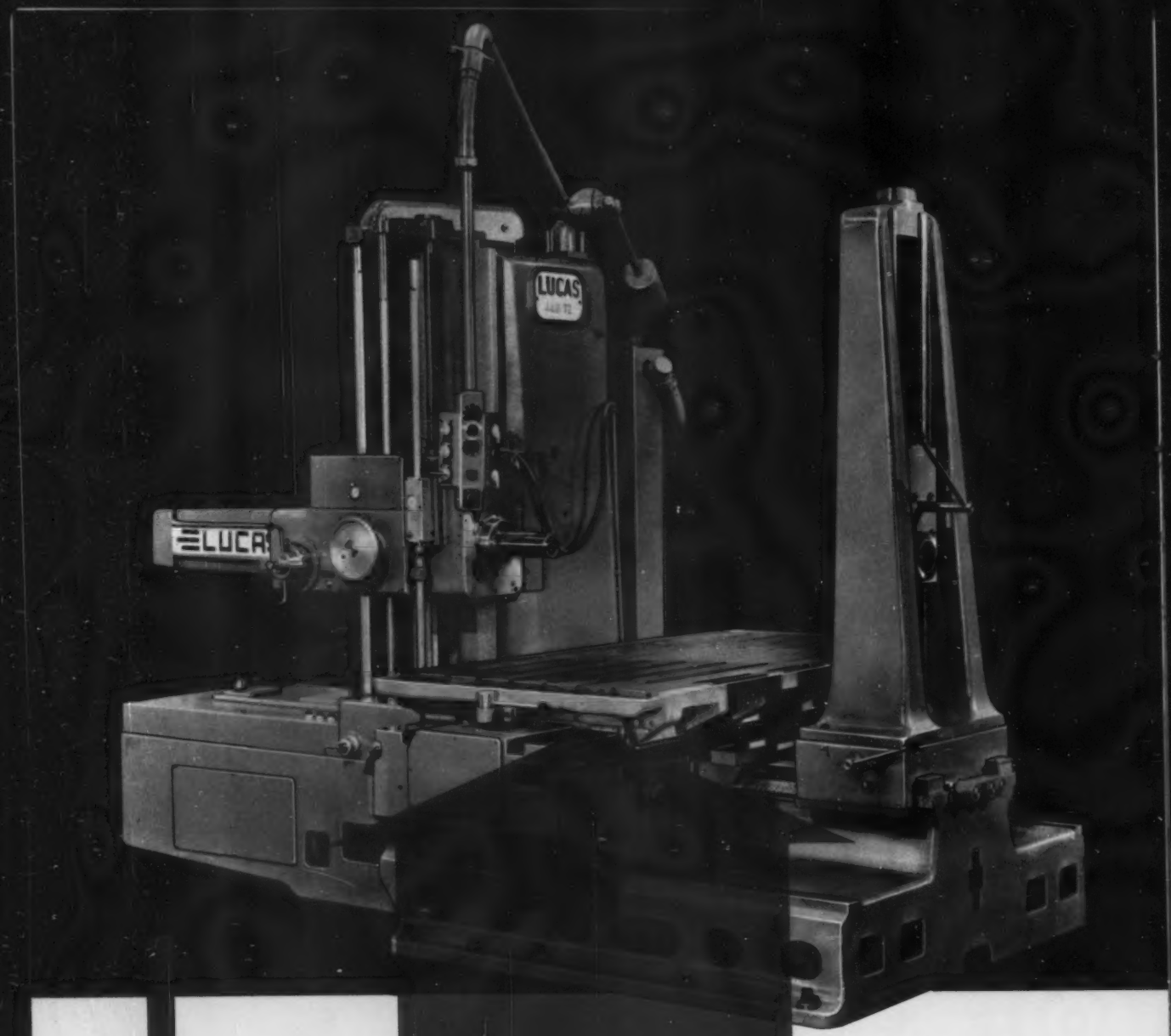




Floor type machines
YES!

A complete line of floor-type, horizontal boring, drilling and milling machines in the 4″ and 5″ spindle diameter range... with all the features and controls available in other Lucas models. Many of these are to be found *only* in a Lucas. *Did you ever meet a man who regretted picking a Lucas?*

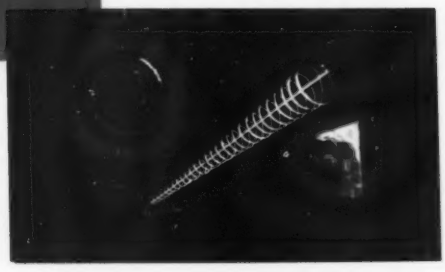
LUCAS
OF CLEVELAND



AIR LIFT*

to saddle and table

All Lucas components are fitted with the utmost precision. To insure lifetime accuracy, the saddle and table ride on lubricated compressed air . . . *ever so slightly above the surface of the ways.* Traverses, either feed or rapid, are silk-smooth and free of wear.



*Patent Pending

LUCAS
OF CLEVELAND

REEVES Vari-Speed Motodrive

packed with new flexibility . . . broader production use

Now available in this compact design, Reeves Vari-Speed Motodrives deliver 2:1 through 10:1 speed variation, 1.8 through 4660 rpm . . . ¼ to 20 hp.

The infinitely variable output speeds meet almost every production need.

You can get these drives with output shaft on same or opposite side of the motor; vertical, 45°, horizontal or trunnion models; no reducer, and single, double or triple stage reductions . . . hundreds of space saving assemblies. Reeves provides a full range of modifications, accessories, and manual, remote or automatic controls. G-1689

Write today for complete data on sizes 100-500 (¼-20 hp) and sizes 8000 (25-40 hp)

REEVES PULLEY COMPANY
Division of **RELIANCE** ELECTRIC AND ENGINEERING CO.
COLUMBUS, INDIANA
In Canada: Reeves Drives • Toronto • Montreal

R MASTER
REEVES

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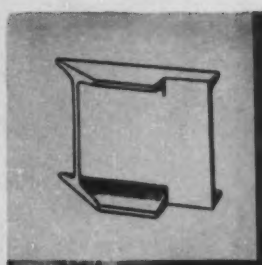
MMT-PE

"The One Machine We Couldn't Do Without"



COPING AND MITERING HEAVY STRUCTURAL SHAPE

18" Beam (above) is held between vises for the short cut. On the long cut (left) vises were removed and beam held by simple clamp. The MARVEL Band Saw is truly indispensable in ornamental and structural iron shops where this type of work is done daily. The machine will cut-off square, miter and cope any work shape from the smallest moulding to 18" I-beams.

SPLITTING CLAMP RINGS, BUSHINGS

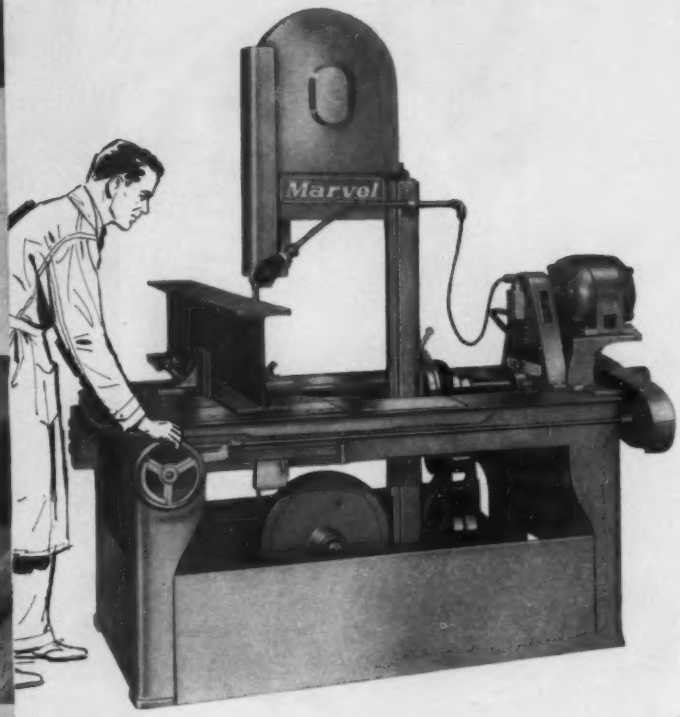
Splitting clamp rings, connecting rods, bushings and collets is a fast, simple operation on the No. 8 Band Saw. Perfect control, quick chucking facilities, accuracy and speed are features that especially fit the machine to handle this type of work.

MITERING LARGE DIAMETER PIPE

Pipe (or any bar shape) may be mitered at a 45° angle without the need for special jigs or fixtures. Even when cutting miters, work remains in the same position as it does for straight cuts. Column and blade are instantly tilted to desired angle, even without stopping the machine. Perfect miters (or lesser angles) are sawed without any layout or special equipment.

SEGMENTING LARGE DIE BLOCK

Three equally spaced re-entrant cuts were made in this 16" x 18" SAE 4130 Forging. Job was completed, floor-to-floor in 5 hours. No special jigs or fixtures were required. An unusual job that serves to emphasize the versatility of the MARVEL No. 8 Saw.



"As simple to use and handy as a Scout Knife" is the way another user described his MARVEL No. 8 Universal Band Saw recently . . . and we can't think of a better way to describe this versatile metal cutting machine.

With a MARVEL No. 8 Band Saw, you can do almost any conceivable straight, angle, or miter metal sawing job—from cutting-off bar stock to making the most unusual forming cuts. You can handle small, delicate work, and in the next minute, saw structurals, or segment large work as illustrated in the lower photograph. You will save time, labor, and material with a MARVEL No. 8 Band Saw because no other saw has all the features to be had in this truly universal tool.

Upright column design and forward travel of the blade through the work (which remains stationary on the table-height saw bed) provides easy, unobstructed visibility and more convenient and efficient working conditions; column can be tilted and locked at any angle up to 45° left and right of vertical; the exclusive MARVEL Power Feed with Automatic Overload Relief; Automatic cutting-depth stops; simple, convenient operating controls—these are some of the features which make the No. 8 Band Saw the most useful—and used—metal cutting saw on the market.

For the complete story, ask or write for Bulletin 875 which illustrates and describes MARVEL Universal Metal Cutting Band Saws.

MARVEL Metal Cutting SAWS
Better Machines-Better Blades

ARMSTRONG-BLUM MFG. CO. 5700 N. BLOOMINGDALE AVE. • CHICAGO 39, ILL.

RUGGED PRECISE ECONOMICAL

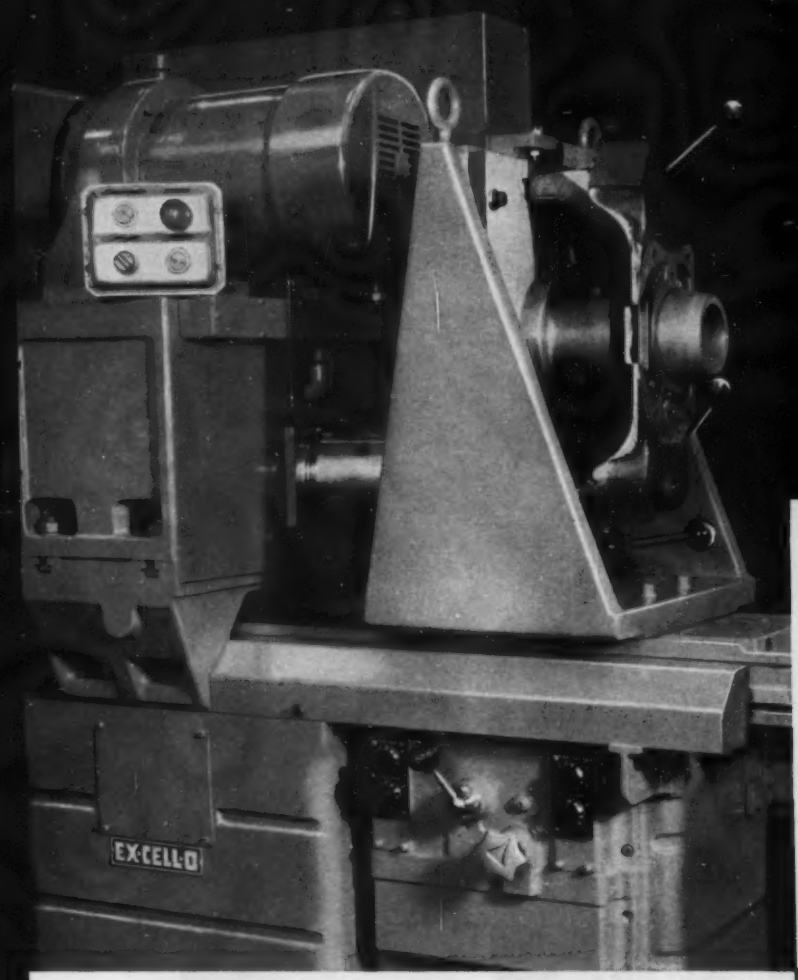
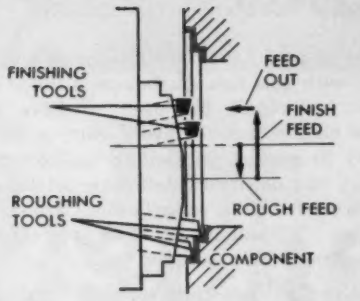


Table pad of the compact Style 2112-B provides ample space for this rugged fixture. Work is shown clamped in position.



Machining cycle and tooling are outlined above, with roughing tools shown fed to depth; finishing is done at opposite end of the feed stroke.

Starter motor mounting of this cast iron clutch housing is faced and bored from rough to finish in one cycle.

59-18

Ex-Cell-O Style 2112-B bores, faces heavy casting in a single cycle

RUGGED for roughing—PRECISE for finishing—ECONOMICAL for short runs

Precision built for boring, turning and facing small or medium-size parts, the Ex-Cell-O Style 2112-B Precision Boring Machine is equally adept at tackling a heavy cast iron truck clutch housing.

The job is done quickly and accurately in one cycle. After clamping, rapid traverse brings the work into position for roughing tools to face two shoulders and plunge two bores. Feed is reversed for finish facing, and table feed-out doubles as a finish-bore pass. A standard hydraulically-operated Ex-Cell-O Facing Head carries the tooling.

Find out how the Style 2112-B or the double-bridge Style 1212-B can put similar flexibility into your operation. Write direct, or ask your local Ex-Cell-O Representative about combining these rugged, time-tested Precision Boring Machines with low-cost tooling for real economy in long runs or limited production.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT.

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General Electric announces the new Adjust-O-Breaker toolholder!

Carboloy® toolholder with adjustable chipbreaker lets you adjust from any angle . . . offers any desired adjustment within its range* . . . features "floating" indexable chipbreaker with absolute repeatability.

MORE jobs with *LESS* tooling—that's what you get with this new Carboloy® Adjust-O-Breaker toolholder! No need to have a separate chipbreaker for every cutting job. No need to restrict yourself to toolholders with only two or three chipbreaker settings. Now you can have this versatile new Carboloy toolholder . . . and *adjust it for any chipbreaker setting within its range.**

Available right now from stock in 5 styles, negative rake, for left- and right-hand machining, the Adjust-O-Breaker truly brings new meaning to disposable tooling.

So, to get cutting tool versatility that lets you handle *more* jobs with *less* tooling, check into the complete Carboloy line—Lift-O-Matic (positive rake, negative rake, and tracer), heavy-duty, and the new Adjust-O-Breaker toolholder. The complete line of Carboloy inserts, insert seats, convertible seats, and brazed tooling is the *broadest* in the industry . . . designed to meet *every* tooling need to give you BETTER PROFITS THROUGH BETTER TOOLING.

See your Authorized Carboloy Distributor now. He's listed in the Yellow Pages. *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Ave., Detroit 32, Michigan.*

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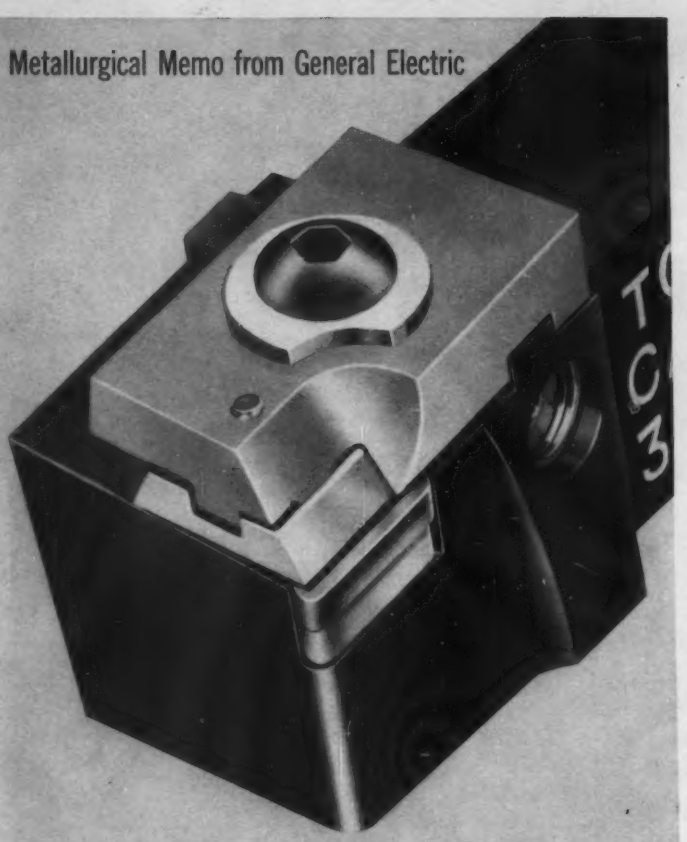
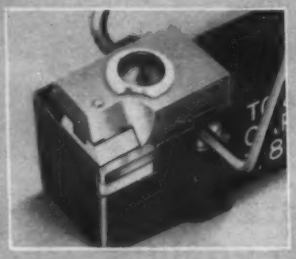
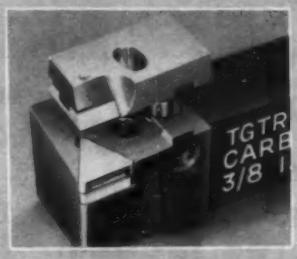
Metallurgical Memo from General Electric



*Sizes 16V and 85V: adjustable range 1/16" to 7/32"
Size 20V: adjustable range 1/8" to 11/32"

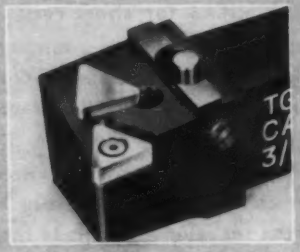


1. Chipbreaker setting adjusts to any width within range.* Set screw with two open ends provides access from either side. No springs to adjust.

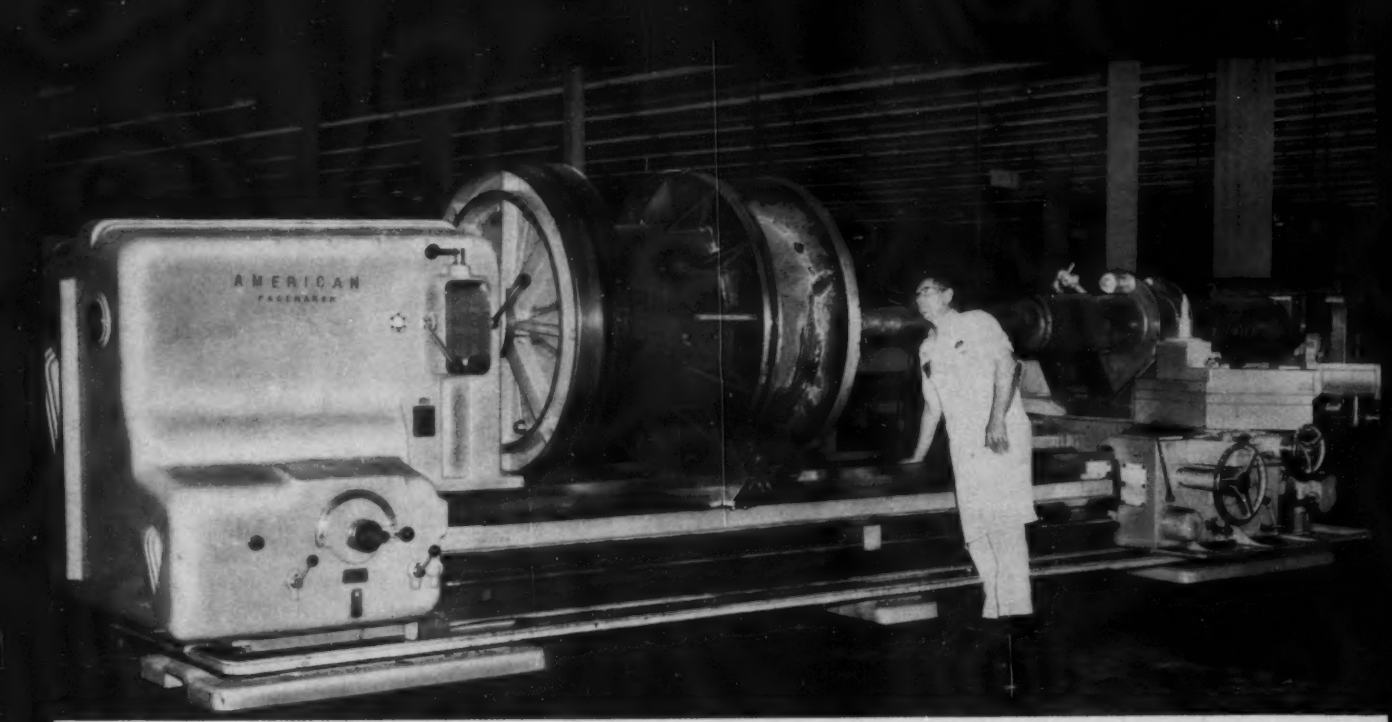


2. Design permits absolute repeatability of settings. Floating chipbreaker is indexable. Can't drop out when clamp is loosened.

3. Clamp screw is accessible from top or bottom; allows easy indexing or replacement even when toolholder is vertical or upside down.



4. Standard disposable inserts, Carboloy insert seats and convertible seat are used with toolholder. Insert seats are indexable and self-aligning.

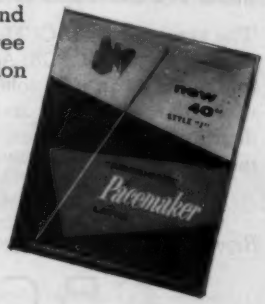


HERE'S THE *VISUAL* ANSWER!

Any question about the capacity of "AMERICAN" Lathe Spindle bearings or the stiffness of "AMERICAN" Spindles is certainly answered by this illustration.

Here is a 40" "J-9" "AMERICAN" Deluxe Model Hydraulic Duplicating Lathe (one of three, 40" "J" "AMERICANS") in the Charlotte, North Carolina plant of the Douglas Aircraft Company, Inc., boring a 54" diameter bulge die weighing five (5) tons. This illustration shows an ingenious roller rest made by Douglas but on many operations no steady rest is used.

This is a 60 horse power lathe with spindle and spindle bearings of tremendous capacities, consequently is ideally adapted to "elephant" operations of this nature and there are other exclusive design features contributing to the excellence of this big lathe, such as the extremely rigid 4-vee bed; the brand new massive 7½" diameter spindle tailstock; the patented three bearing, triple drive spindle; its 100% anti-friction construction and full automatic oiling.



The many ultra modern and superlative features of "AMERICAN" Deluxe Model Pacemakers are described and thoroughly illustrated by bulletin No. 150. May we send you one?

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

A new standard of accuracy...

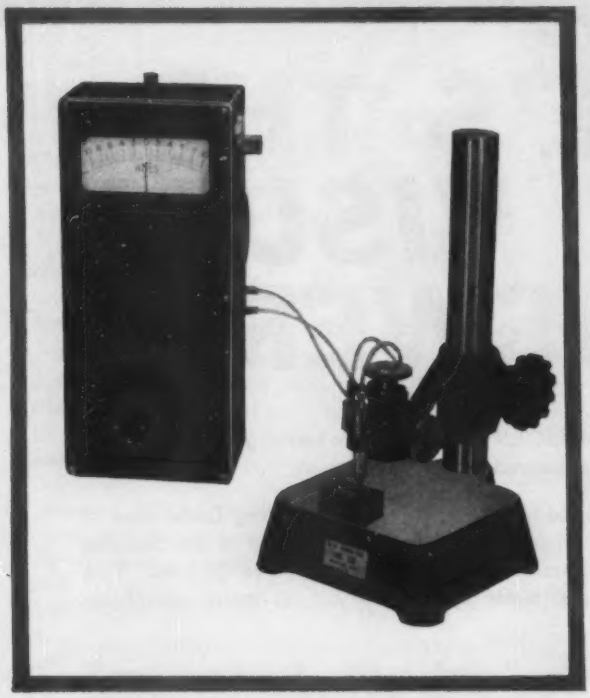
ACCU-FLOW* by AMES

B. C. Ames has perfected a new concept in air gauging ... ACCU-FLOW ... which offers extremely fine measurement and unusual stability.

Key feature of the ACCU-FLOW system is a new patented nozzle which provides a high degree of sensitivity and excellent linearity.

ACCU-FLOW is the answer to many measuring problems that were once considered impossible to solve. The ACCU-FLOW system includes: *gauges that provide a continuous record of wire diameter, and determine the roundness of balls or shafts ... a contour tracer that permanently records contours in greatly enlarged scale ... automatic sorting gauges ... a non-contact follower gauge* and *a gauge for measuring grinding variations.*

For complete information on the entire line of AMES air gauging equipment, write for new ACCU-FLOW folder.



AG5 ACCU-FLOW Air Gauge

The versatility of ACCU-FLOW equipment is indicated by Model AG5. Adaptable to less than five millionths of an inch tolerances, the AG5 can be used as a contact comparator, flatness comparator, depth gauge, hole gauge, continuous non-contact measurer or comparator, and a grinding gauge.

AG7 ACCU-FLOW Air Gauge Recorder

The AG7 Air Gauge Recorder gives you a permanent record of continuous measurement. Measurements are recorded on a 2"-wide chart paper by a Sanborn "hot needle." As in other ACCU-FLOW models, the nozzle may be placed a considerable distance from the recording unit.

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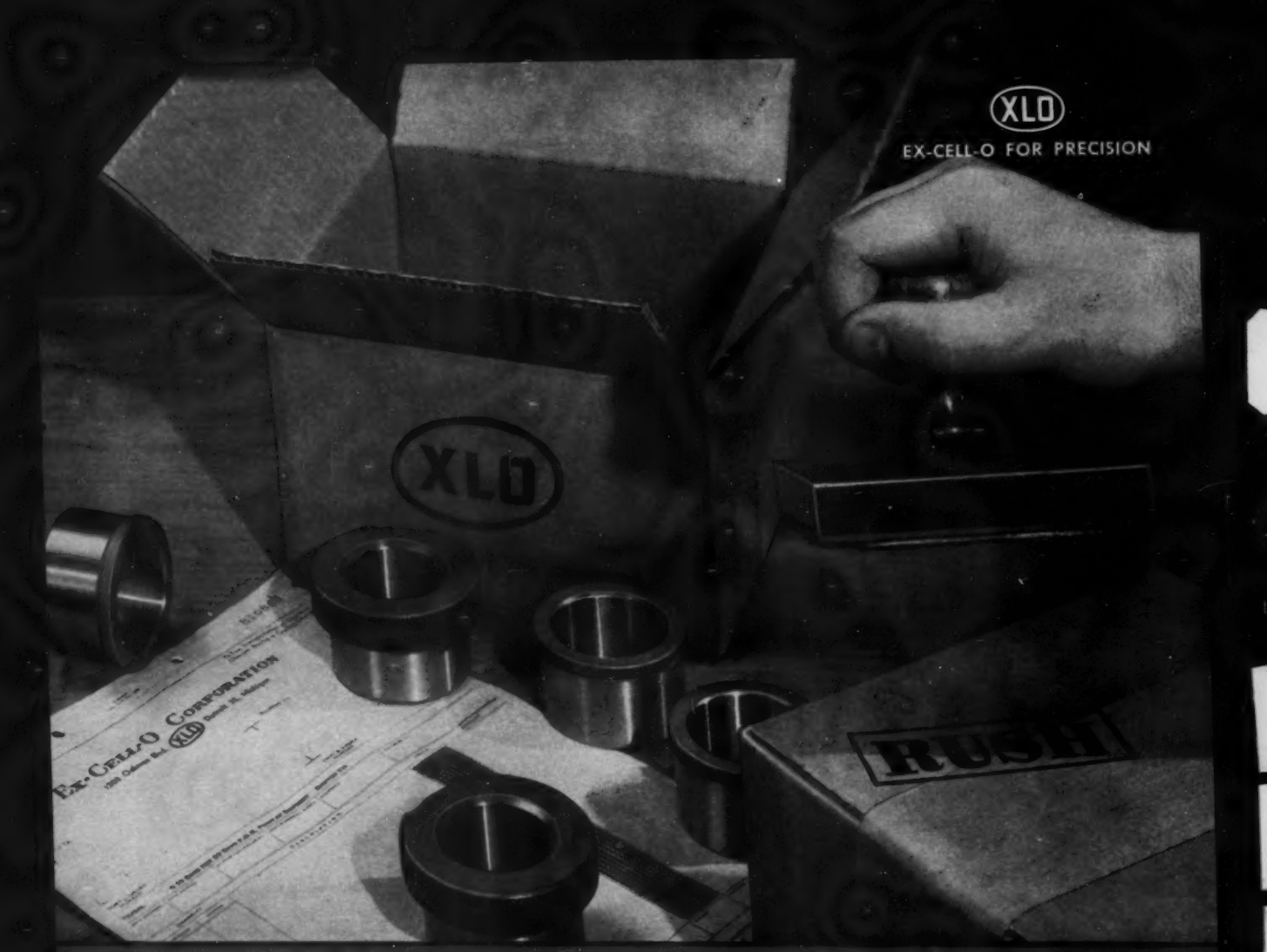

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For more data circle this page number on card at back of book

Now . . . crown-shaved gears standard equipment on Clausing 12¾" lathes!

All gears on Clausing lathes are crown-shaved for quieter, smoother operation and greater accuracy than ever before. It's another PLUS feature that makes Clausing truly outstanding among lathes in its class. Here are a few of the many more—

(1) Flame-hardened bed ways standard equipment at no extra cost.

(2) Heavier throughout—"have more guts than most of our machines costing 3 or 4 times as much."

(3) Forged steel spindle, with L-00 or 2¼"-8 threaded nose.

(4) "Zero Precision" Timken tapered roller bearings.

(5) Choice of heavy-duty variable speed or 10-speed countershaft, with clutch and brake optional.

(6) Verified precision—factory test report accompanies each lathe.

The result . . . this user report is typical of the performance and value you get in Clausing lathes: "After investigating the lathe field very thoroughly our choice was Clausing, and subsequent performance exceeded our expectations. We recommend the Clausing 6300 series lathes as the competition-beating answer in their capacity range." (signed) K & W Machine Works, Springfield, Mass.

See Clausing . . . check, feature for feature, dollar for dollar . . . before you buy any lathe of comparable size. See for yourself why Clausing is acclaimed the outstanding lathe value.

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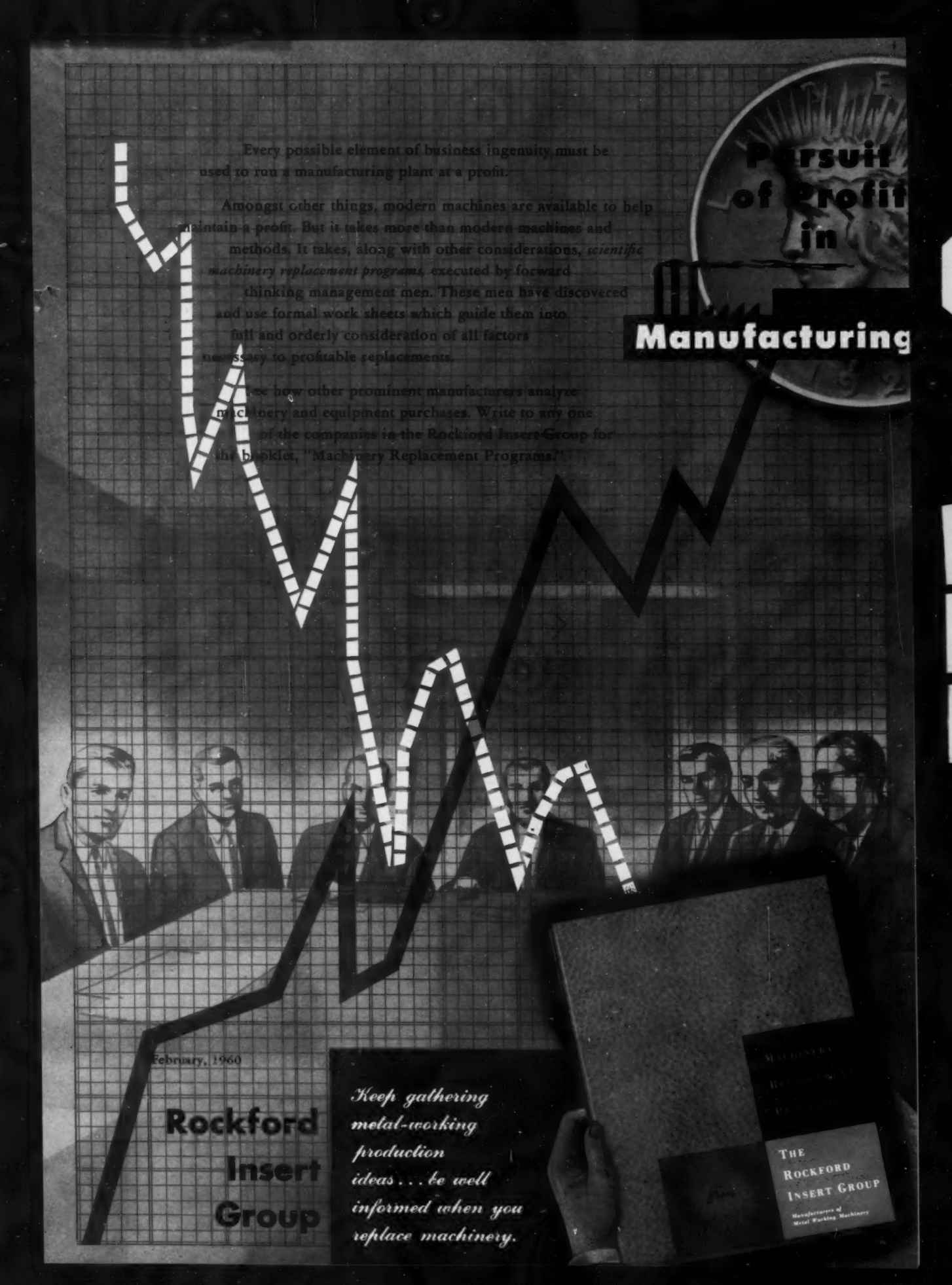
Every possible element of business ingenuity must be used to run a manufacturing plant at a profit.
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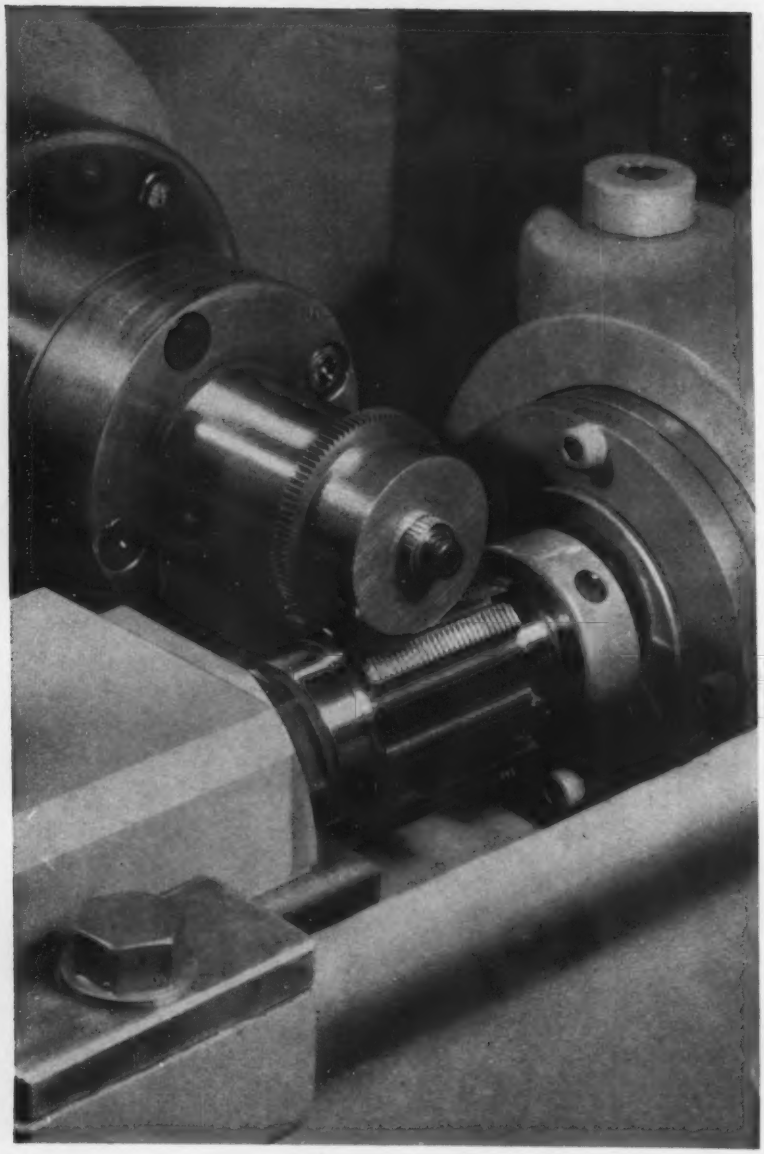
New method of producing

AGMA Precision



Selection and segregation no longer necessary to insure precision-matched spur gear sets

Selection and segregation — the process of producing more gears than you need in order to select a few that are within Precision Class 2 or Class 3 tolerances — is no longer necessary. And, these jobs at PIC Design Corporation, East Rockaway, L.I., New York, prove it.

In pioneering "Ultracision" accuracy for the missiles industry, Barber-Colman Company developed extensive machining and testing techniques now embodied in a new, low-cost hobbing machine—the No. 2½-4. For mass production of easily machinable parts which do not require such a high degree of accuracy, a high-speed version of this machine is available with a maximum hob speed of 2400 rpm.

Completely new hobbing machine

New concepts have been introduced into the Barber-Colman No. 2½-4 to bring you exceptional accuracy at a nominal cost. The No. 2½-4 is guaranteed to index accurately within 20 seconds of arc. This means that nonadjacent spacing error on a 2" dia. gear would be only .0001" due solely to the indexing error of the machine. When rigid tooling . . . accurate blanks . . . care in mounting the hob and work . . . Class AA hobs . . . and accurate hob-sharpening methods are used, it should be possible to hob AGMA Precision Class 2 and Class 3 gears without selection and segregation. Scrap and inspection time are reduced. And, in many

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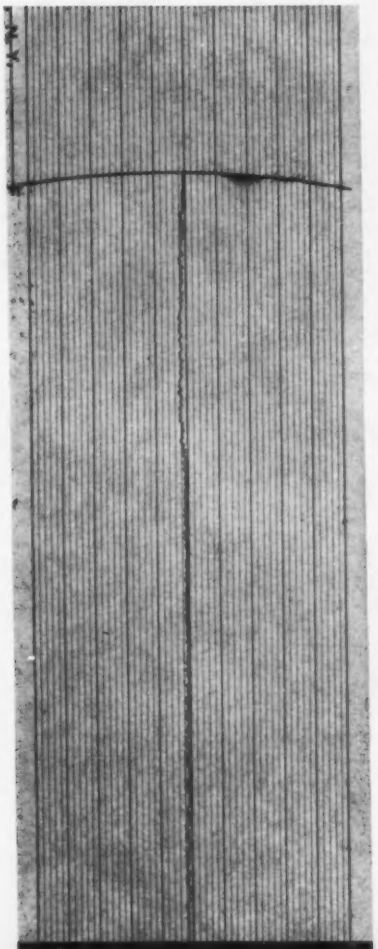
Class 3 Gears



Each line on tape represents .0001". This Precision Class 3 gear was obtained with only slightly more care than required for Class 2 gears.

cases, deeper savings can result from the elimination of finishing operations.

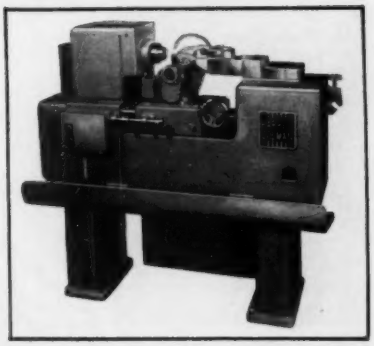
The accompanying PIC "true blue" gear tape shows the inspection record of a Precision Class 3 gear. On the production run, all gears had a total composite error of less than .0004". The gears have 96 teeth of 64 DP. The tape is made on a variable center-distance checking machine with a motor-driven master gear which rolls under preset pressure with the cut gear. After the work spindle adapter and the hob were trued within .0001", no further adjustments were necessary for hobbing gears of this accuracy.

The No. 2½-4 accommodates 3" dia. hobs, permitting maximum number of flutes for cutting accurate, smooth tooth profiles. Maximum work diameter is 2½" and length of cut is 2¼" — for steel gears as coarse as 30 pitch or brass up to 20 pitch.

PIC pursues accuracy in every corner of production

As you examine the results being achieved with the No. 2½-4 by PIC Design Corporation, you will see that in their pursuit of predictability and precision, no stone is left unturned.

Bores of Precision Class 2 and 3 gear blanks are machined to +.0002", -.0000" for size and roundness. Before turning, blanks are mounted on arbors the same size as the bores, with a .0002" taper. They are inspected for face wobble and must run true within .0002" per inch of diameter before the OD's are turned to a concentricity tolerance of .0001". This operation is checked at two points, 180 deg. apart.



In hobbing, the arbors are held in a floating adapter which permits fine adjustment to desired concentricity. PIC uses only Barber-Colman Class A or AA hobs, trued on the machine to less than .0001" runout.

Evaluate your gear processing and costs

If you have the problem of producing precision fine-pitch gears at a profit or want to improve your product by increasing gear accuracy, a Barber-Colman process analyst will help you evaluate methods, tooling, and cost improvements. Phone your B-C representative or the factory — WO 8-6833.

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"Custom" milling machines

TYPE OF MACHINE	Heads			Tables		Saddle	Columns		Controls		
	Vertical	Horizontal	All-Angle	Horizontal	Rotary		Fixed	Cross Travel	Pendant	Tracer	Tape
1 SIMPLEX		•		•			•	•	•	•	•
2 DUPLEX		•		•			•	•	•	•	•
3 TRIPLEX	•	•		•			•	•	•		
4 UNIVERSAL BED TYPE		•	•	•			•	•	•	•	•
5 VERTICAL	•			•	•	•	•	•	•	•	•
6 ROTARY TABLE	•	•			•		•	•	•	•	•
7 OMNIMIL			•	•		•	•		•	•	•
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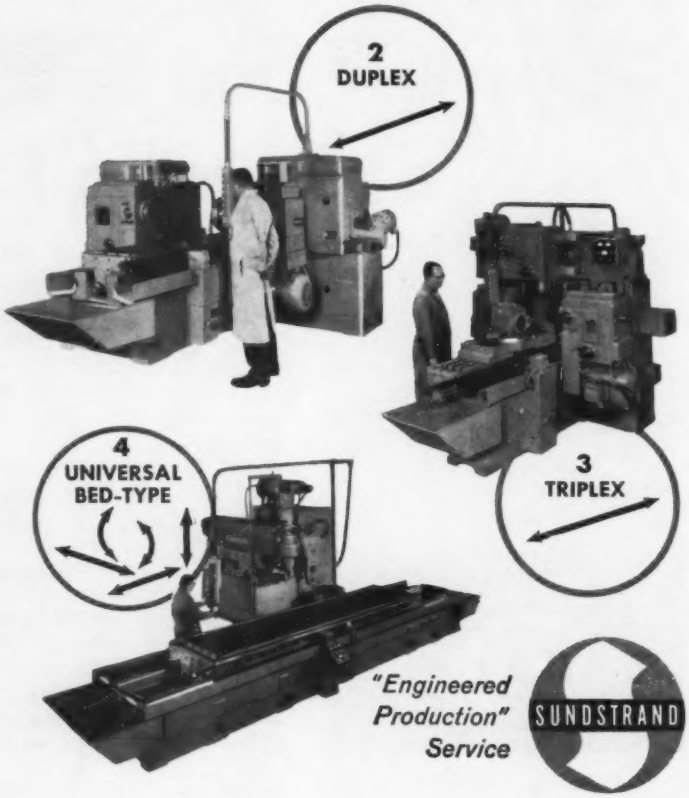
Look at the Sundstrand line pictured here — it offers you special machine productivity at standard machine cost!

Sundstrand design engineers have created unit heads, tables, columns, and other elements in sizes, types, and horsepowers to provide an almost unlimited range of combinations to exactly meet your production requirements. For example, Sundstrand catalogs more than 138 standard Simplex and Duplex machines, not including the variations shown in the table above. Attachments such as vertical feed to horizontal heads, power feed to quills, automatic index bases, etc. provide additional cycle combinations.

Sundstrand application engineers offer you "Engineered Production" service that helps you "put together" the versatile machine that best meets your needs. And you get extra protection against obsolescence because if your work requirements change, you can modify the machine by changing the head.

For complete information and literature, write today.



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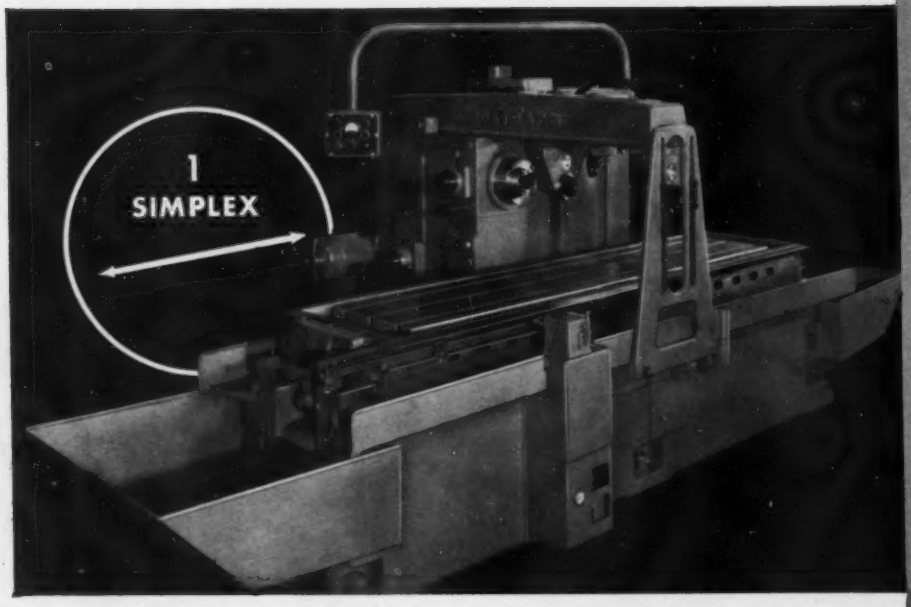
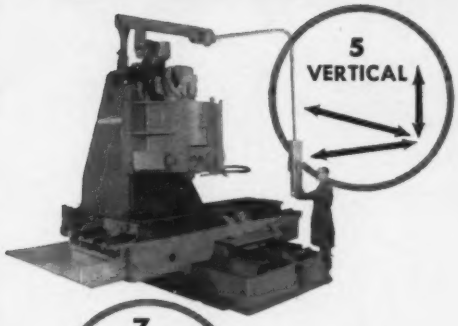
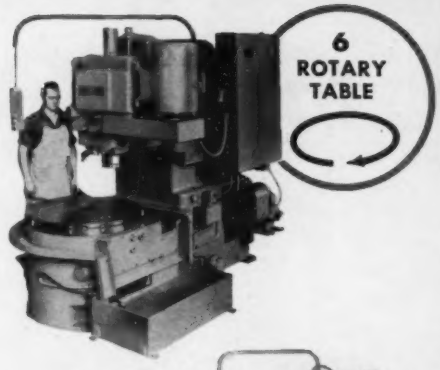
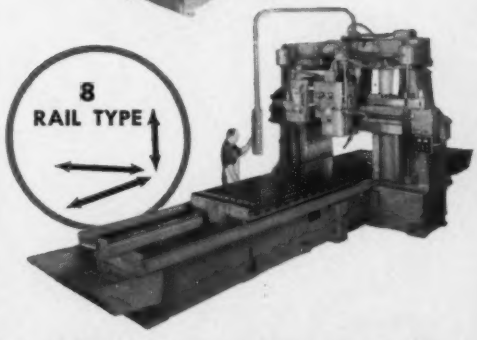
from standard components









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Literature listed under various machine types has more details. Write Sundstrand for your copy today.

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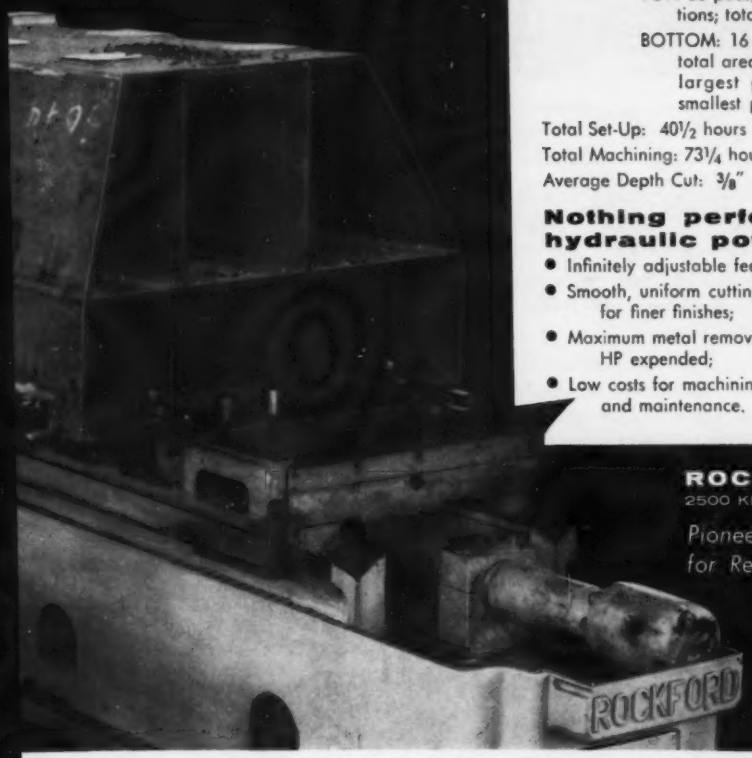

SAVES 33% HOURLY COST, 15% TOTAL PRODUCTION TIME ON THIS JOB.

Operation: Using auxiliary rail, planes top and bottom pads on Paper Mill Drive base, 10' 2½" wide x 18' 3¾" long x 3' 5¾" high, weighing 8½ tons.

TOP: 26 pads, 6 different elevations; total area 2806 sq. in.

BOTTOM: 16 pads, one plane total area 3168 sq. in. largest pad, 12" x 54" smallest pad, 4" x 9"

Total Set-Up: 40½ hours

Total Machining: 73¼ hours

Average Depth Cut: ⅜"

Nothing performs like hydraulic power:

- Infinitely adjustable feeds and speeds;
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- Maximum metal removal per HP expended;
- Low costs for machining, cutting tools and maintenance.

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MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Straight-through surface grinder turns out plowshares like popcorn

Precision Grinding Operation Easily Integrated into John Deere's Automated Line

As this job illustrates, surface grinding is particularly adapted to automation—probably more so than most operations because it avoids downtime ordinarily required for servicing cutter-type tools.

This Mattison "special" grinds bevels on plowshares at the rate of 720 per hour—double the production of two manually operated machines.

When officials of John Deere Plow Works, Moline, Illinois, saw demand for their new high-speed shares outstripping production capacity, they began a search for a surface grinder that would adapt best to an automated line. They wanted conveyorized work flow, from cutoff, forging, blanking, piercing, heat-treating, quenching, drawing, roll forming, grinding, and shot peaning . . . to painting and packaging. And they knew that the answer to their grinding problem would be a straight-through machine, particularly in view of the knife-like surface to be machined on the joint edge of the share.

Unique features of the grinder (Fig. 2)—features which have established the machine as the automation prototype for a variety of flat pieceparts—include:

Fig. 1—Automatic loading is from a magazine which prevents piling up of plowshares by reversing the conveyor drive when more than 15 shares are stacked.

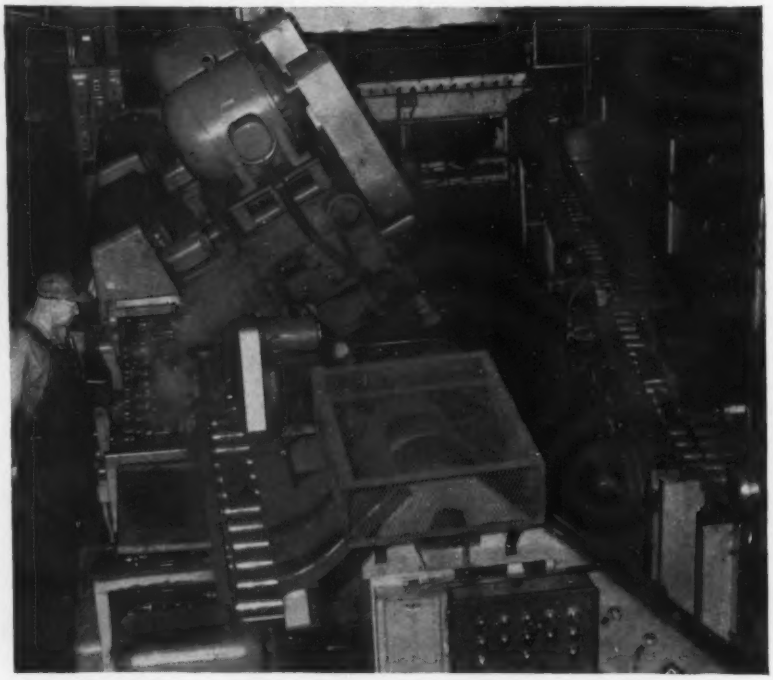

Fig. 2—Automatic straight-through grinder is fed by a conveyor from the roll-forming machine (lower right). Parts are finished in a single pass through two heads at the rate of 720 pieces per hour.

1) Recirculating workholding pallets (22) are loaded, clamped, unclamped, unloaded, and cleaned automatically.

2) Spindle quills are mounted in a parallel rocker-arm suspension which eliminates conventional ways.

3) The 75-hp spindle motors, mounted on top of the grinding heads, assure positive cutting action by applying high unit pressures to the workpiece.

4) An automatic sizer continuously measures the workpiece and actuates the spindle infeed when parts approach their size limit. This compensates automatically for wheel wear . . . and when self-dressing wheels are used, the only downtime is for replacing worn segments.

On the pallets, clamping pressures and positions of the locating pins and driver pins can be adjusted easily for 16 different plowshare sizes.

Considering automation?

If you are faced with the problem of expanding production capacity or reducing costs, investigate automatic surface grinding by Mattison.

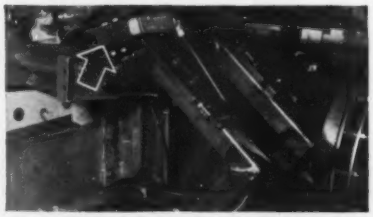

Fig. 3—Cam-actuated clamps open automatically at the unload station. Magnet (arrow) lifts shares from pallets and drops them onto the outgoing conveyor.

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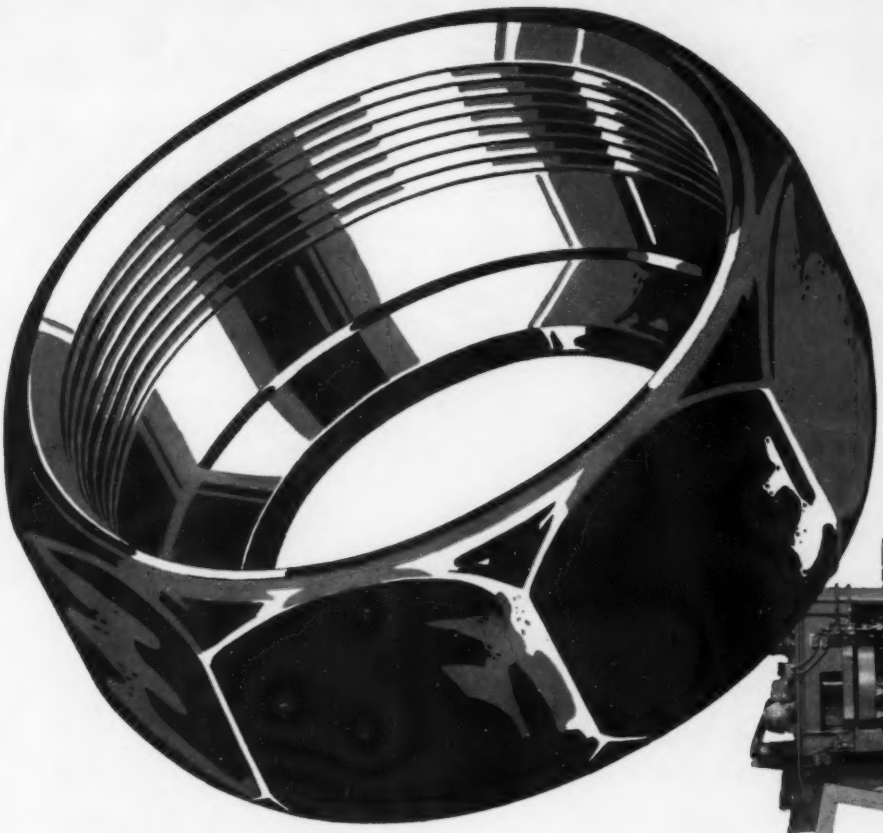
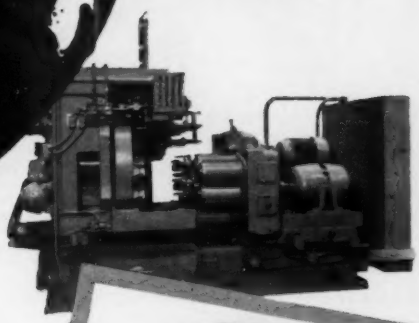
MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

...an example of Automatic Production by Greenlee...



MMT-PE



700 malleable iron pipe fittings an hour...

The Greenlee 5 station, horizontal, automatic indexing machine shown above was designed and built for high-production machining of malleable iron pipe fittings. The pipe fittings are loaded, four at a time, indexed and machined at the rate of 576 to 712 pieces an hour, depending on size. The machine accommodates five different sizes of fittings.

STATION 1 — automatic load
STATION 2 — bore and rough counter-bore
STATION 3 — finish counter-bore and chamfer
STATION 4 — tap
STATION 5 — automatic unload

Let a Greenlee representative show you the modern Greenlee approach to automatic production.

MACHINES DESIGNED . . .
WITH THE FUTURE IN MIND

GREENLEE

TRANSFER MACHINES

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

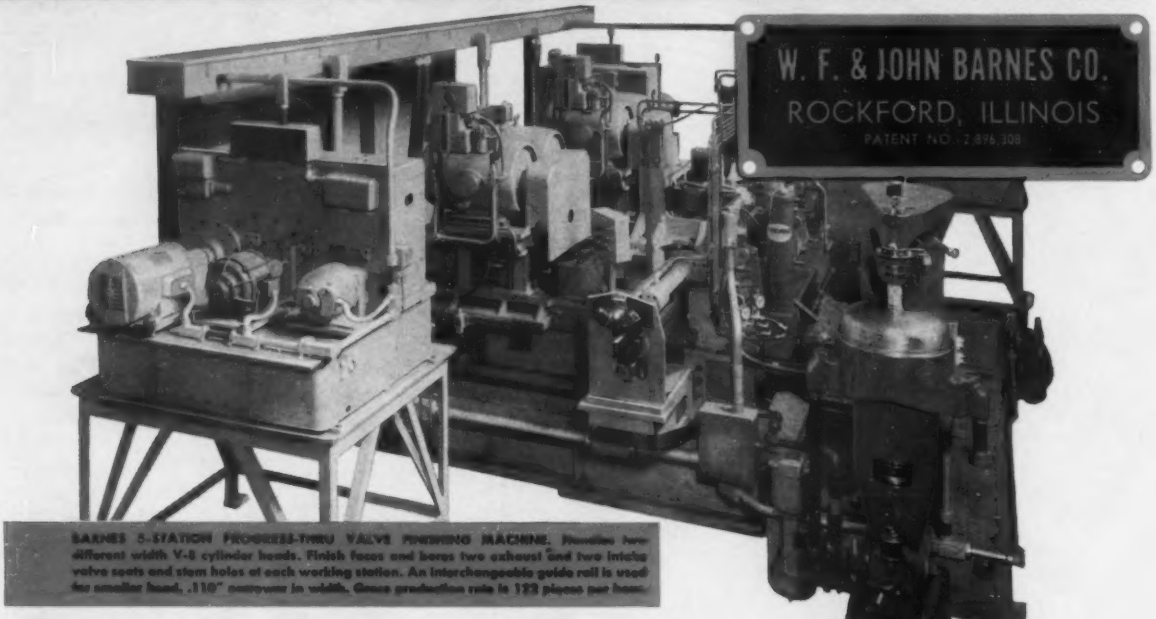
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Units
- Die Casting Machines
- Trim Presses

GREENLEE BROS. & CO.

1702 MASON AVE.
ROCKFORD, ILLINOIS

FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass



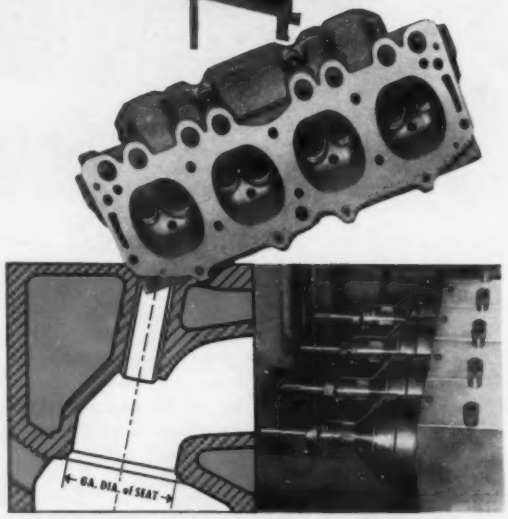
BARNES 5-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide rail is used for smaller head, .110" narrower in width. Gross production rate is 123 pieces per hour.

Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.



CONCENTRICITY .0005" T.I.R.
Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0003" T.I.R.

DUAL-TYPE PRECISION SPINDLES
Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines Since 1872

W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. *Write for New Catalog* illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

New ROL-PAK slips over dispenser rail, tape strips off in seconds. Printed, color-coded tapes identify ring type and size. All or part of ROL-PAK may be used at one time.

TIME EXPOSURE COMPARISON

Old stack-rod set up requires two hands. Uses up valuable production time.

New ROL-PAK set up is far simpler and quicker; requires only one hand.

New Truarc ROL-PAK speeds ring assembly, handling

ROL-PAK* is a new method of pre-stacking retaining rings for faster, more economical assembly on production lines. Pre-stacked on a color-coded tape, the rings are quickly identified by type and size. Available to users of Truarc Retaining Rings exclusively, ROL-PAK provides production flexibility, and allows faster and more efficient assembly set-up.

On your production line, ROL-PAK slips over the dispenser rail ready to use. The pressure sensitive tape is stripped off in seconds. With the old stack-rod packaging, by contrast, an operator had to remove the cotter pin, hold the bottom rings on the rod to prevent their slipping off then carefully position the rod on the dispenser rail . . . a much more time consuming, less-efficient method.

Here are important ROL-PAK advantages for you to consider: *Faster assembly* because of quicker, easier loading as illustrated above. *Easier identification* of ring size and type, right on the printed, color-coded tapes. *Greater flexibility* since all or part of ROL-PAK may be used. *Easier handling, storage* with no protruding stack-rods.

ROL-PAK is available in Truarc Series 5103 Crescent® rings, 5133 E-rings and 5144 Reinforced E-rings in most widely used sizes. All present types of Truarc ring dispensers may be easily converted to ROL-PAK.

The design advantages of Truarc retaining rings, have led to their ever increasing use in production of products of all kinds. The new Waldes Truarc Assembly Tool Catalog AT 10-58 covering assembly tools, pliers, applicators, dispensers and grooving tools belongs in your files—write for it. And on special application problems, Waldes Truarc engineers will be glad to help. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.

*Pat. Pending ©1959 WALDES KOHINOOR, INC. 9.10

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N.Y.

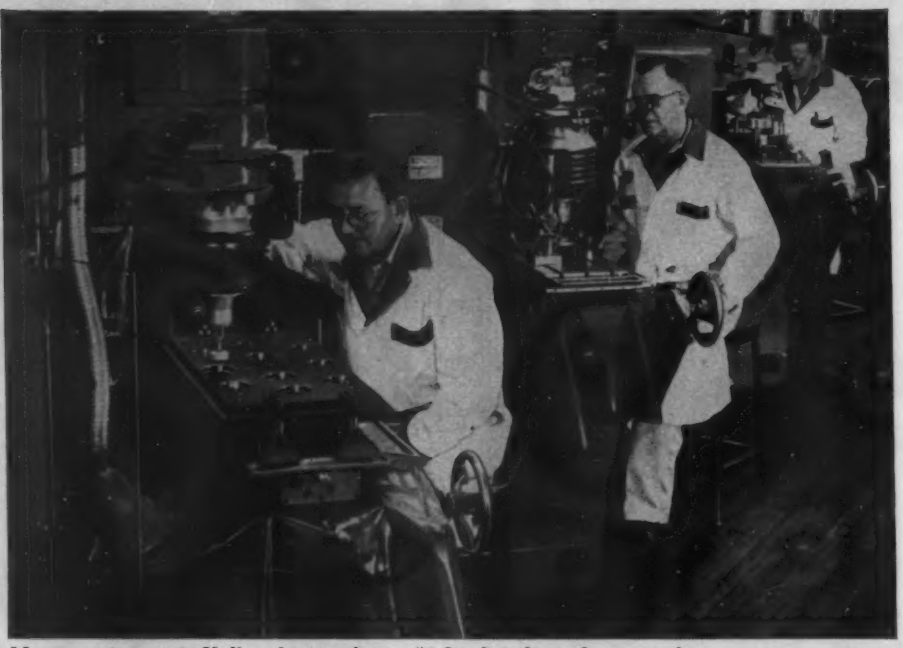
TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

For more data circle this page number on card at back of book

Val Koller tells why he continually adds more Moore Jig Borers and Jig Grinders to his team

This is another in a series featuring the views of owners of leading tool and die companies.

by **VAL KOLLER**
President
Koller Die & Tool Co.,
Milwaukee, Wisconsin
Manufacturer of Dies
and Metal Stampings—
Tools—Jigs—
Fixtures and Gages—
Special Machines



Moore equipment in Koller plant, with new #3 Jig Grinder in foreground.

"Since our foundation in 1919 it has been my personal objective to strive for perfection. Since that time perfection has evolved into a .000010" word for tool and die makers. Such precision is rapidly becoming common-place...particularly in electronics and guided missile fields of production. With the installation of Moore equipment in 1950, we have been able to compete successfully in a caliber of work that before was not possible.

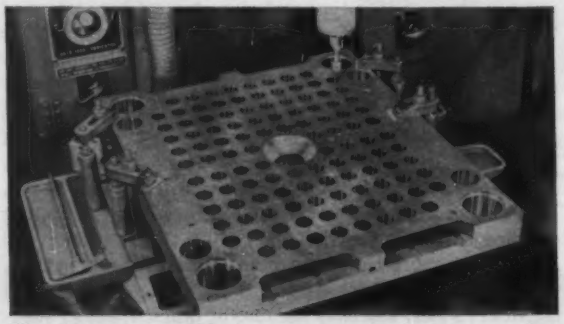
"Since that initial investment in a Moore Jig Grinder we have continually added Moore teammates to our toolroom. Today we operate more Moore equipment than any other top contract shop in the greater Milwaukee area.

"The tolerances and intricate contours now required make Moore Jig Borers and Jig Grinders a must in each toolroom. These machines operate at full capacity each workday with negative downtime due to mechanical failures. In fact, we have found that it costs real dollars and cents to operate *without* Moore equipment.

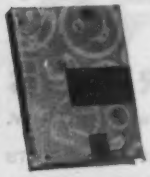
"This cost factor is just one of many reasons why we recently added another teammate to our toolroom ...the new Moore Model #3 Jig Grinder. This machine, with its tenth-splitting accuracy, hardened ways and wider range, enables us to service more customers better."

Write today for literature describing the unique features of #3 Moore Jig Borers and Jig Grinders or see our catalog in SWEET'S MACHINE TOOL FILE.

MOORE SPECIAL TOOL COMPANY, INC.
734 Union Avenue, Bridgeport, Connecticut



This 116 cavity mold plate was completely jig ground at Koller on a Moore Jig Grinder. Tolerances: hole location ± .0001", hole diameter ± .0001".



HOLES, CONTOURS AND SURFACES, tells how to produce tools and dies *the modern way*. 424 pages, 495 illustrations. $5 in U.S.A. $6 elsewhere.

ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES

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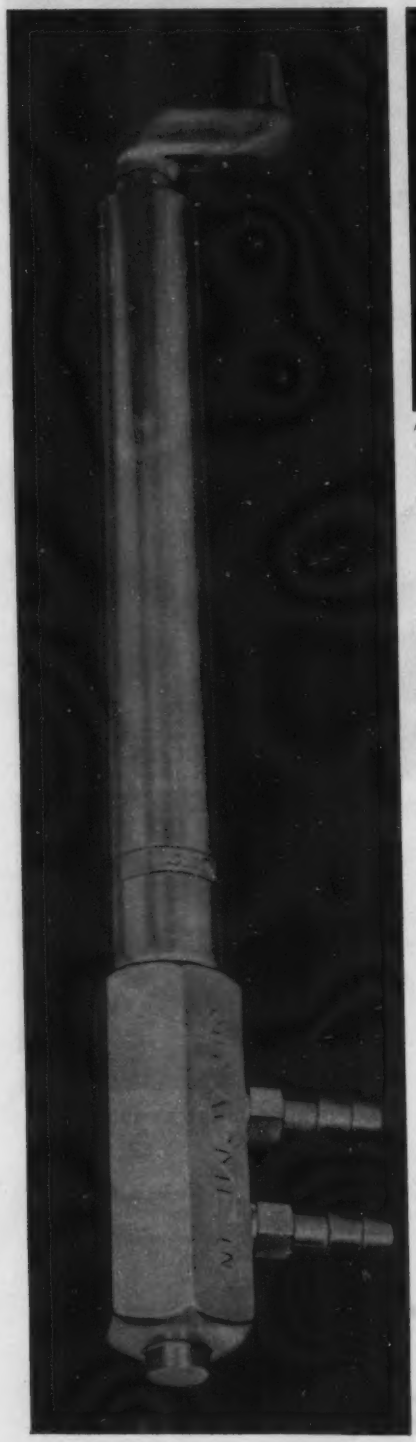
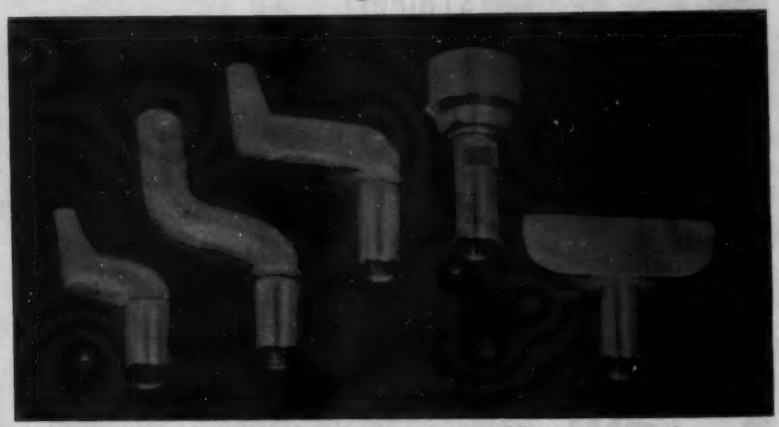
SPOT-WELDING TIPS and

electrodes of Chromium Copper-999 give superior service in high production resistance welding





Acme Electric Welder Co., Los Angeles, a leading resistance welding equipment manufacturer, produces standard spot-welding tips from Chromium Copper-999 rod, seam-welding wheels from Chromium Copper-999 sheet. Irregular shaped tips, above, are Anaconda die-pressed forgings of Chromium Copper. In pieces fabricated from rod, bar, or sheet, strength and hardness are increased by cold working after heat treatment. Anaconda gives forgings an additional cold strike after hot forging to increase surface hardness. *Left:* A forged welding tip in an Acme water-cooled tip holder.

IN resistance welding the electrodes must carry heavy currents under high pressures and at elevated temperatures. They must be made of materials that have high electrical and thermal conductivities and mechanical properties that will keep deformation and wear to a minimum. The widespread and growing use of resistance welding has stimulated research to meet the demand for more efficient and durable electrode materials.

CHROMIUM COPPER-999, one of Anaconda's high-strength, heat-treatable alloys, is an excellent electrode material with a record of superior performance in high-production welding. Electrical and mechanical properties exceed those listed for RWMA Class 2 material. Electrical conductivity is about 80% IACS and thermal conductivity is comparably high. In addition it has tensile strength of about 70,000 psi after heat treatment (compared with 48,000 psi for hard drawn ETP Copper), and its mechanical properties remain high at temperatures approaching 400 C. Available as rod, bar, sheet, tube and die-pressed forgings.

Anaconda also offers Hitenso®-961 as a more economical electrode material for use where service conditions are not severe enough to require the higher properties of Chromium Copper-999. Its properties exceed those of RWMA Class 1 material, having electrical conductivity of about 85% and tensile strength of about 60,000 psi. Available as rod, bar and plate.

TECHNICAL ASSISTANCE. For further information on these Anaconda alloys or for technical assistance in the selection of the right alloy to meet special problems, see your American Brass Company representative. Or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

RESISTANCE WELDING ELECTRODE MATERIALS
ELECTRICAL COPPERS • WELDING RODS

ANACONDA®

PRODUCTS MADE BY THE AMERICAN BRASS COMPANY

STRIPPIT SUPER 30 FABRICATOR

Larger work sizes for more efficiency...for short run punching — 30" x any length ...for production run hole duplication — 25" x 30".

Adjustable table for greater accuracy and flexibility...for punching to closer tolerances in angles, shapes and formed parts as well as flat sheets.

New, no-jam electric head eliminates down time...and the need for pressurized air. Fewer parts minimize maintenance — ensure quieter, more positive operation.

Wide range of hole punching capacities...from a 3½" hole (round or shaped) in 16 gauge to a ½" hole in ¼" mild steel.

Corner and edge notching...up to 5" x 5" in 16 gauge mild steel — 90° corners, rectangular, vee, radii and special shape edge notches.

Straight line nibbling and contour shearing...at 165-strokes per minute in ⅛" mild steel. Instant changeover from single stroke punching.

New swing-shift punch holders...quick-opening, positive-closing — for right or left-hand operation. Electrical interlock for safety.

Exclusive quick-change tooling system...using standard stock punch and stripping guide assemblies and die buttons. Size changes take less than 20 seconds.

New quick-set gauging system...with micrometer settings for fast, accurate layout and rapid work positioning.

EASY CONVERSION TO A PRODUCTION PUNCHING UNIT...

with the Strippit Duplicator which can be built-in as an integral part of the Super 30 Fabricator — and the Dupl-O-Scope for punching Duplicator templates from a drawing, layout or sample part.

WRITE TODAY... for complete details, illustrated literature, price and delivery.

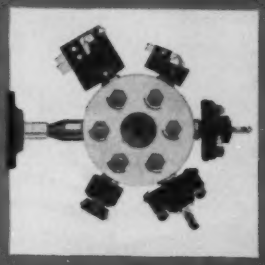
UNIT OF HOUDAILLE INDUSTRIES, INC. WALES

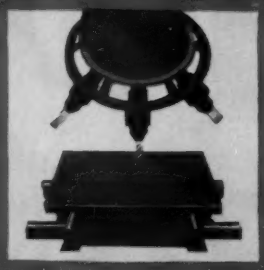
STRIPPIT INC.

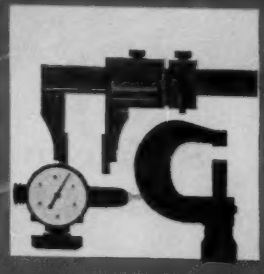
203 Buell Road, Akron, New York

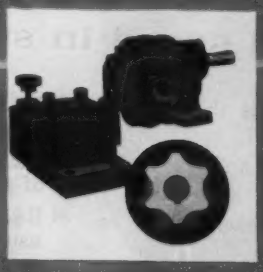
In Canada: Strippit Tool & Machine Company, Brampton, Ont.

to help you make more for less









Brown & Sharpe

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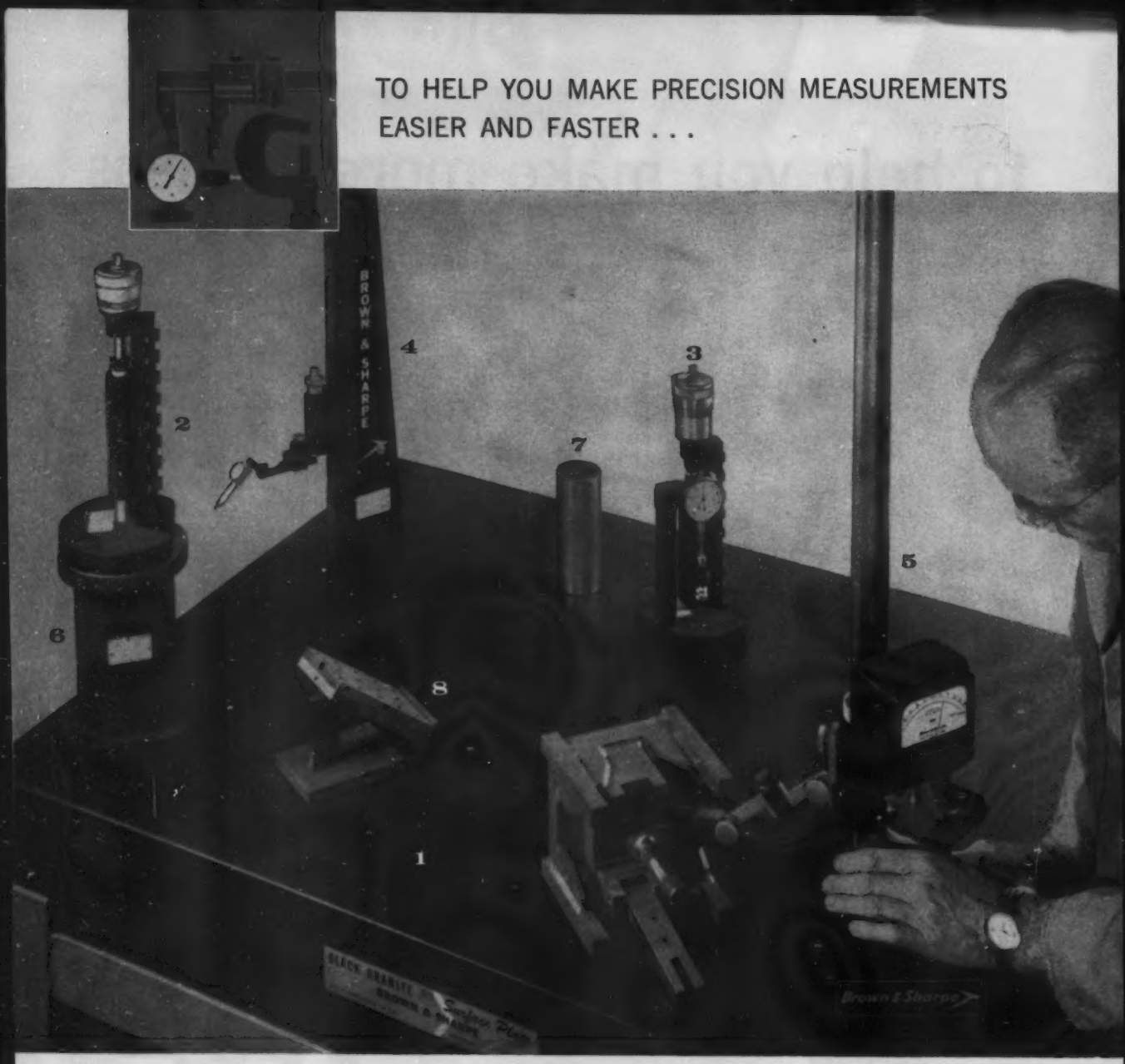
TO HELP YOU MAKE PRECISION MEASUREMENTS EASIER AND FASTER . . .



8 Brown & Sharpe tools bring you unusual new precision and speed in surface plate work

1 B&S Black Granite Surface Plate is the flattest, most indestructible base you can buy.

2 Hite-Set® establishes heights fast and easily in ten-thousandths.

3 Dial-equipped Hite-Icator® works even faster to provide the same accuracy.

4 Hite-Chek® transfers measurements without losing a single ten-thousandth. It is "chatterproof."

5 Super Hite-Chek works even finer; in 25 millionths and better. It's transistorized; a snap to use.

6 B&S 9" Riser Blocks, made to gage block accuracy, stack under other tools in measuring tall work.

7 B&S Direct Reading Cylindrical Square shows out-of-squareness directly in 2 ten-thousandths.

8 B&S Inspection Sine Plate sets angles with unusual precision. Available in 5" and 10" simple and compound models. Ask your Brown & Sharpe distributor to show you the complete line of accurate B&S surface plate tools. Brown & Sharpe Mfg. Co., Providence 1, R. I.

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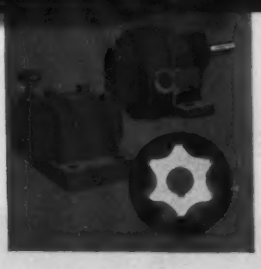


TO HELP YOU HANDLE FLUIDS
MORE EFFICIENTLY... AND FOR LESS

Save up to 75% on valve installations with new Double A "Circuit-Stak"

Circuit-Stak valves are a new Brown & Sharpe concept: a "sandwich" of several valves required for a hydraulic circuit, assembled in one compact unit on a single sub plate.

You save up to 75% of the usual installation cost for separate valves, because Circuit-Stak installs as easily as a single valve — eliminates separate mountings and piping runs. Valves in the sandwich can be easily removed or replaced.

For literature on Double A hydraulic control valves, power units, Gerotor pumps, write Double A Products Co., a subsidiary of Brown & Sharpe Mfg. Co., Manchester Michigan.

Above: Simple Circuit-Stak combining double flow control valve, "sandwiched" under 4-way valve, costs about $36 less to install than if valves were separately mounted.

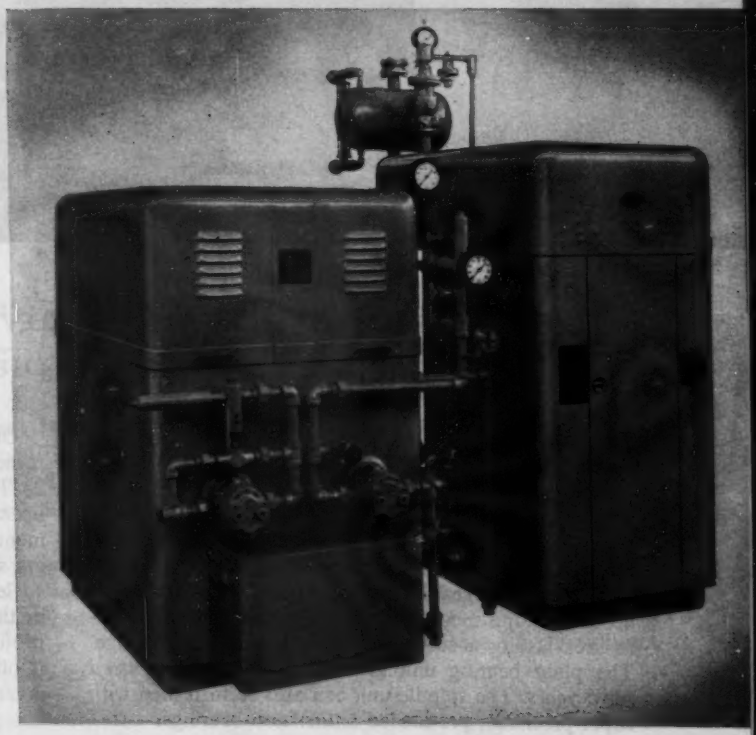
Below: Famous Votator chilling and plasticizing units for shortening and lard are manufactured by Girdler Process Equipment Division, Chemetron Corporation, Louisville, Ky.

Unusually long life of B&S pumps suits them for "Votator" units

The reasons why Brown & Sharpe rotary geared pumps have been built into "Votator" vegetable-shortening and lard processing units for over 15 years, are important to any pump user . .

First, B&S tolerances between moving parts are so close that they reduce slippage of hot oils to an absolute minimum — at 250-300 psi. Second, B&S fine internal finishes assure extra-long service life. Equally important, the B&S pumps that meet Votator requirements so well are *inexpensive* — available right from stock.

Send for your copy of the new Catalog No. 36P, which describes the complete line of B&S gear, vane and centrifugal pumps. Brown & Sharpe Mfg. Co., Providence 1, R. I.



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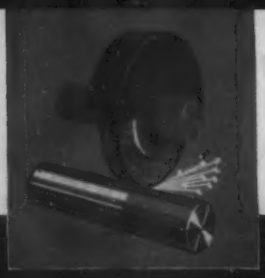
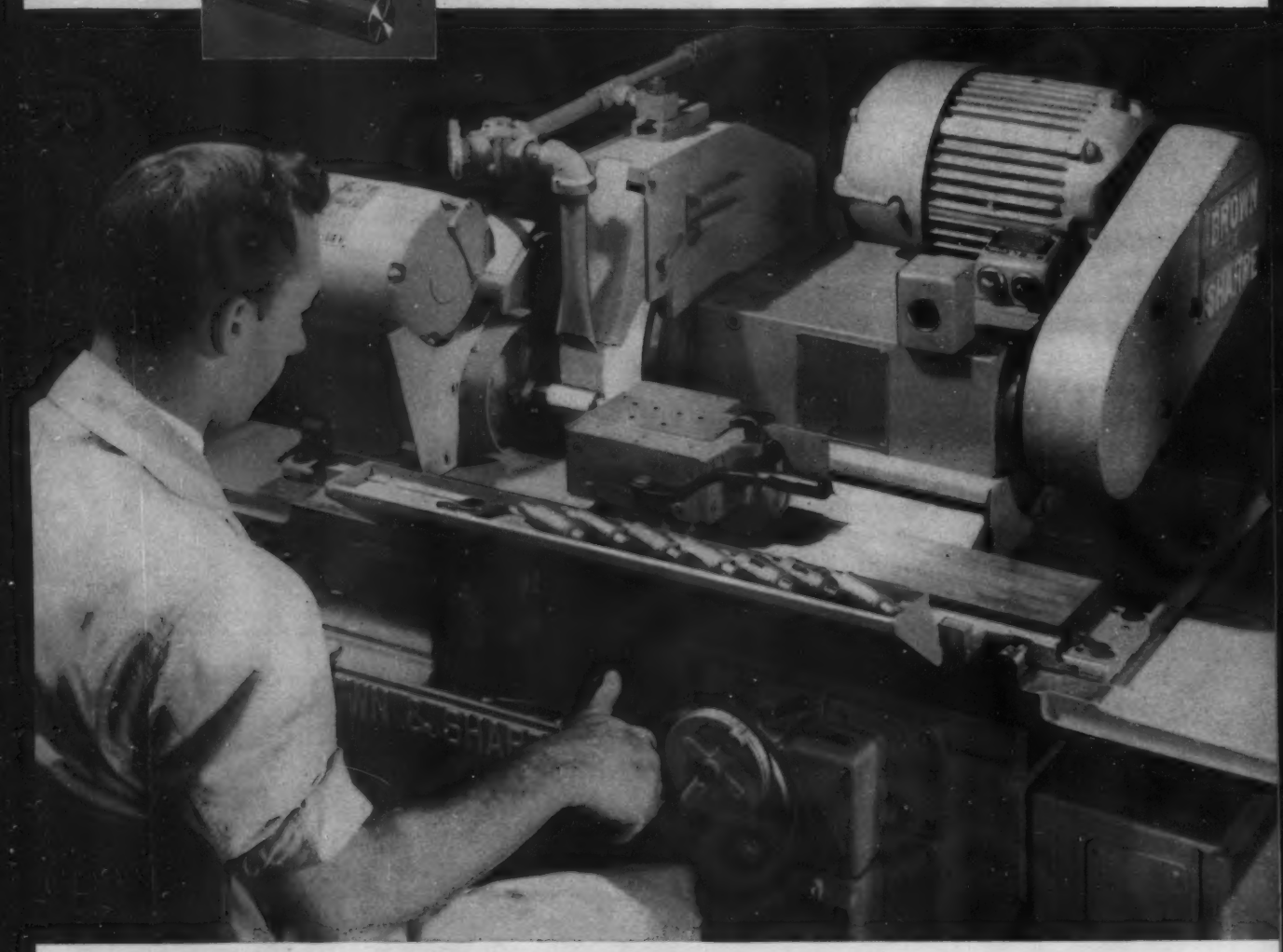


TO HELP YOU GRIND MORE FOR LESS



New design No. 5 - the only plain grinder with a 5-year guarantee on a plain bearing spindle

The Brown & Sharpe No. 5 Plain Grinding Machine has remained first choice for production grinding of small parts for good reasons — its accurate repetitive sizing to split tenths, and its long record of cost-saving performance. Now, exclusive new advantages set today's top standards for operating efficiency and economy.

The interchangeable cartridge-type wheel spindle unit needs no adjustment, has self-contained lubrication — assures lasting accuracy in the low micro-inch range. The plain bearing unit is unconditionally *guaranteed for 5 years*. The spindle unit can also be furnished with super-precision, pre-loaded antifriction bearings.

Other design features available only in the new No. 5 include 1) super-smooth Oriflex drive in headstock; 2)"Permalign" footstock that permits fast, easy lever-operated work loading, and maintains accurate alignment; 3) flat swivel table top that is a horizontal working surface, hardened and ground for lasting accuracy.

Before you buy equipment for production grinding in the 1" range, get complete information on all the profit-saving features of the new No. 5. You'll see why it offers you by far the best return on your machine investment. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

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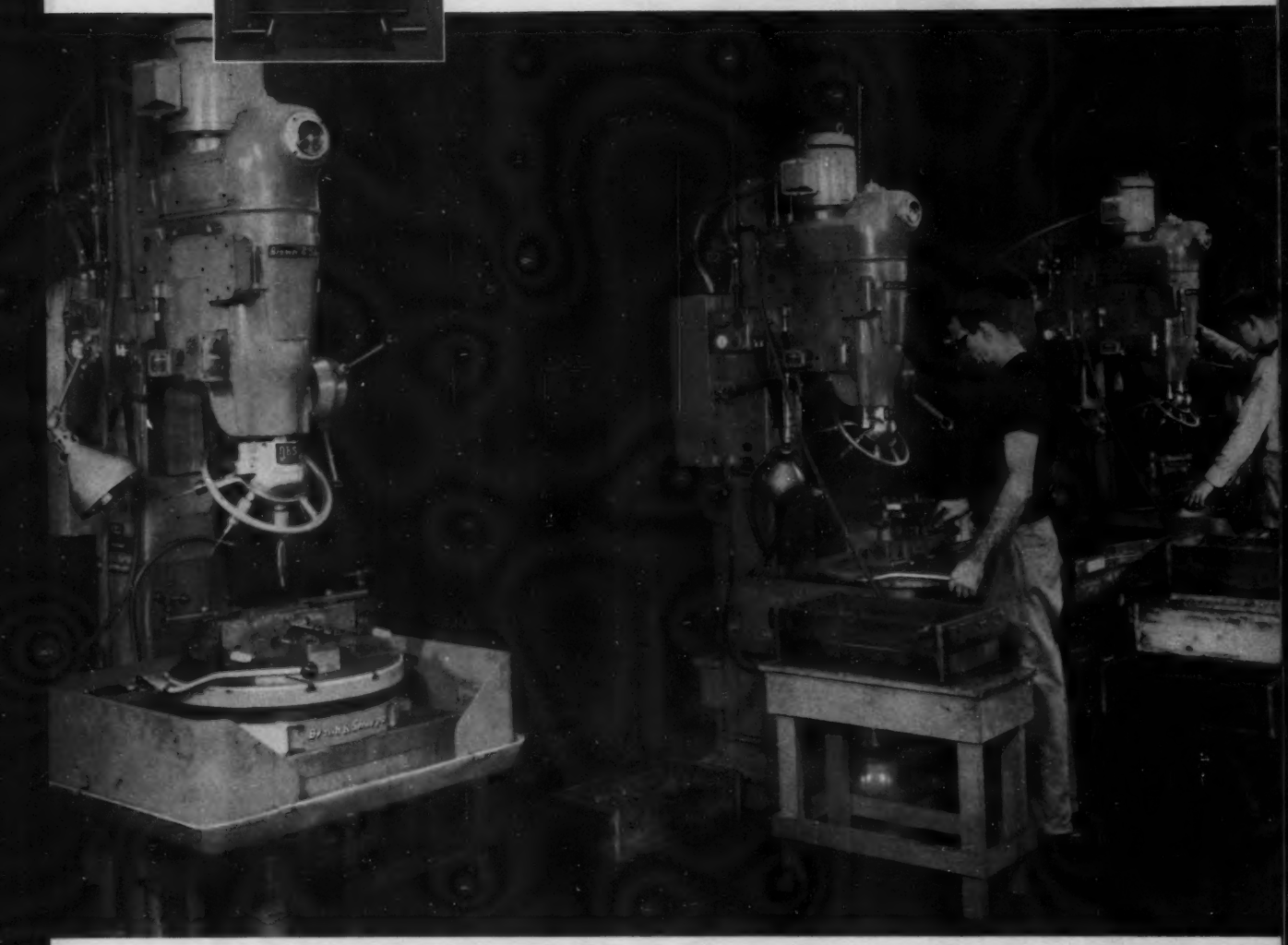
TURRET DRILLING MACHINES...
TO HELP YOU DRILL MORE FOR LESS



American Hardware speeds production with Brown & Sharpe Turret Drilling Machines

At The American Hardware Corporation, three B&S Model A Turret Drilling Machines are used to machine 15 fitting points in mating parts. B&S Positioning Tables and simple holding fixtures maintain accurate relationship of machined surfaces.

With previous method, involving transfer of parts to several machines, dimensional relation of fitting points frequently varied. Parts had to be individually mated in assembly, often by hand filing and fitting.

Five hollow-milling and two face-milling operations are performed on the B&S Turret Drilling Machines, as well as drilling, tapping, and reaming. In all, 21 operations are performed on each complete part in 4 minutes total machining time.

Find out how you can save with Brown & Sharpe Turret Drilling Machines — in work transfer and set-up time, in jig costs, in tool wear and maintenance — in capital investment and floor space. Write: Turret Drilling Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

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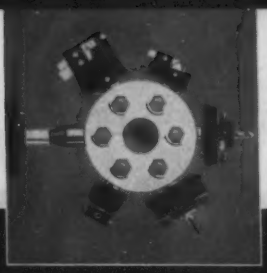
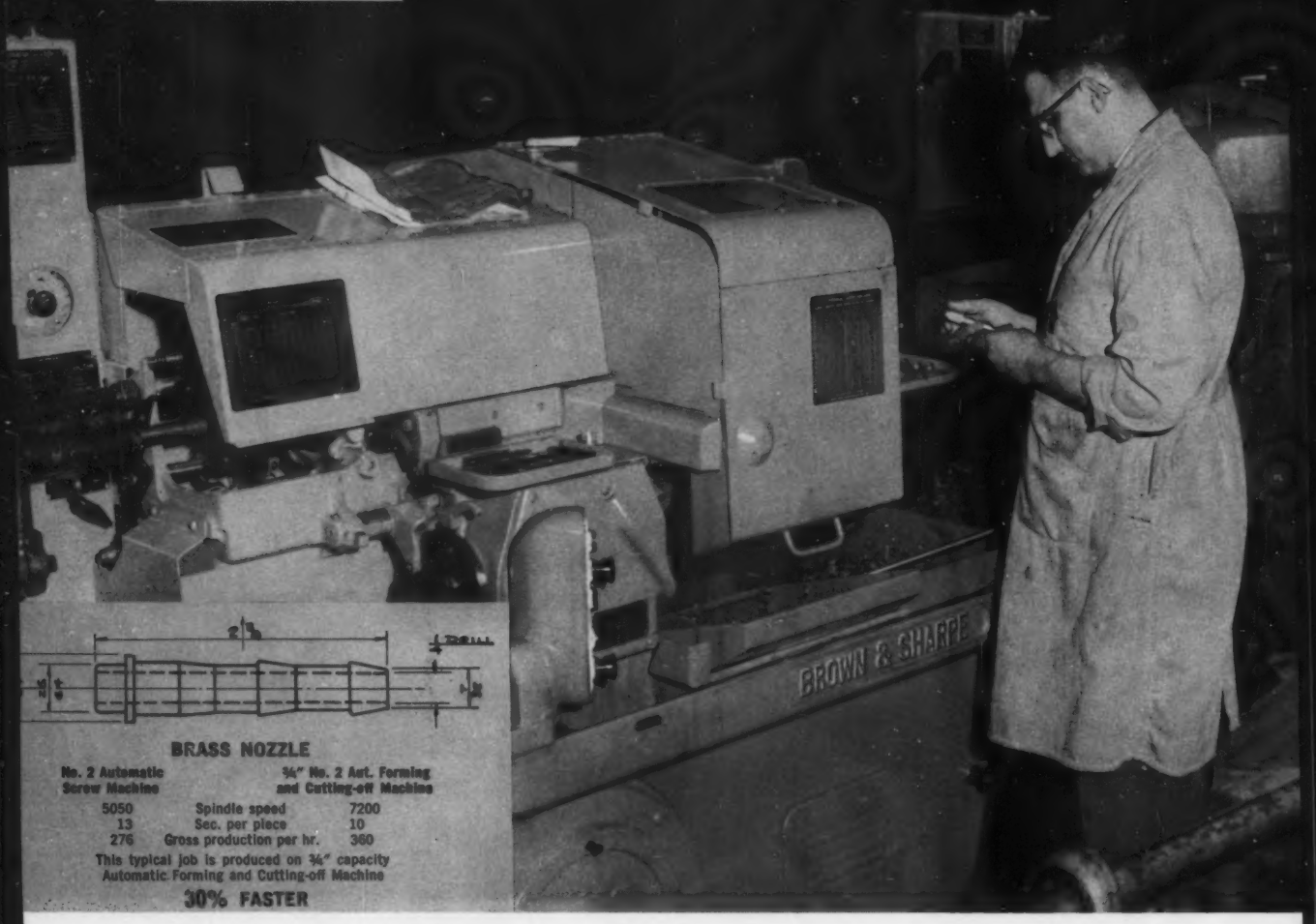


TO HELP YOU REDUCE
SCREW MACHINE PRODUCTION COSTS



BRASS NOZZLE

No. 2 Automatic Screw Machine		¾" No. 2 Aut. Forming and Cutting-off Machine
5050	Spindle speed	7200
13	Sec. per piece	10
276	Gross production per hr.	360

This typical job is produced on ¾" capacity Automatic Forming and Cutting-off Machine

30% FASTER

Now - No. 2 Automatic size range and productivity - in a high speed forming and cutting-off machine

The new Brown & Sharpe No. 2 Automatic Forming and Cutting-off Machine, with six-hole turret and vertical slide, will perform practically all automatic screw machine operations except threading. For the big volume of bar work that does not require spindle reversal or stopping, it delivers all the record-setting efficiency and precision of the new-design B&S Automatics.

You get all the increased production potential of higher spindle speeds — up to 7200 R.P.M. for free-machining materials, with a full range down to 315 R.P.M. for tough alloys. You can take full advantage of carbide tooling and make multiple savings in production time. You get tolerances to 0.0005" on many jobs when forming or turning from the turret, with excellent surface quality. You get extra adaptability for combined operations, and for faster set-ups. Your equipment investment is substantially reduced, with a big plus in productivity.

The new No. 2 is available in 3 sizes — ¾" capacity with 18 speeds from 7200 to 450 R.P.M.; 1¼" capacity with 18 speeds from 5050 to 315 R.P.M.; 1½" capacity with 16 speeds from 3500 to 315 R.P.M. For complete details, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

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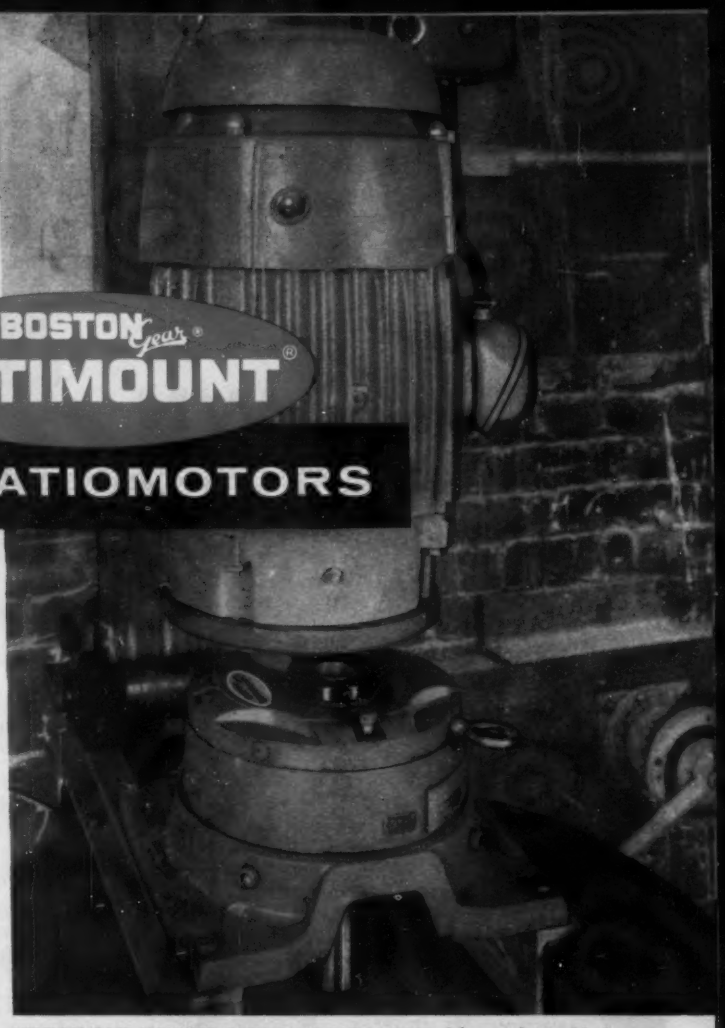
When the job calls for
"~~gearhead motor~~"

cost-wise designers specify

BOSTON Gear®
OPTIMOUNT®
HELICAL GEARED RATIOMOTORS



Add up the SAVINGS and see why . . .

YOU SAVE DESIGN TIME. Optional mounting gives full scope to your designing skill. Drive arrangements are not restricted by the mounting limitations of conventional gearhead motors.

YOU ELIMINATE EXTRA COST OF SPECIALS. With OPTIMOUNT Ratiomotors FROM STOCK, you can meet hundreds of unusual drive conditions that would require "specials" in conventional gearhead motors. You save the delay and extra cost.

YOU REDUCE PARTS COST. Since OPTIMOUNT offers a choice of many output shaft positions, you can design for direct lineup — and eliminate extra couplings, bearings, and other parts needed to "hook up" a conventional gearhead motor.

YOU SPEED PRODUCTION. Order the OPTIMOUNT you need with a phone call to your local Distributor, for delivery FROM STOCK. You can start production without delay, maintain schedules, and avoid big inventory expense.

YOU SIMPLIFY SERVICING. All OPTIMOUNT components are standardized stock parts — available promptly from over 100 BOSTON Gear Distributors throughout the U. S. and Canada.

Ask your BOSTON Gear Distributor for complete information. Boston Gear Works, 65 Hayward St., Quincy 71, Massachusetts.

VERTICAL BASE MOUNTED OPTIMOUNT RATIOMOTOR drives agitator blade shaft on pigment mixers in coated textiles plant. Manufacturer says: "OPTIMOUNT adaptability permitted simplified, efficient design for our specific needs . . . at a much lower cost for the complete installation."

Meet any in-line drive mounting conditions with STANDARD STOCK models

Vertical or horizontal base mounted — for any floor, wall, or ceiling mounting position — choice of many shaft positions in either base — single or double reduction helical gearing — for ¼ to 10 hp drives. Sold also without motor, ready for attachment of separately purchased motor of your choice.

Order from your nearby Distributor and get any arrangement you specify — ready to install

FROM STOCK!
at factory prices

Horizontal base mounted

Ask for Catalog No. 57

CALL YOUR NEARBY
BOSTON Gear® DISTRIBUTOR
— STANDARDIZATION PAYS —®

For nearest Distributor LOOK UNDER "GEARS" in the "Yellow Pages"

Advt. copyright by Boston Gear Works

ARMSTRONG

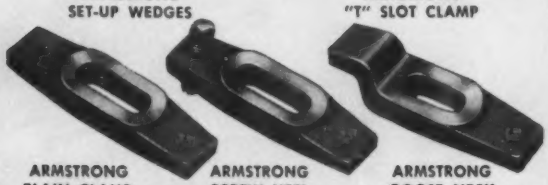
SET-UP *and* HOLD-DOWN TOOLS

ARMSTRONG PLANER JACK — ARMSTRONG BRACING JACK — ARMSTRONG VERTICAL JACK — ARMSTRONG ADJUSTABLE STEP BLOCK

ARMSTRONG "T" SLOT BOLT — ARMSTRONG "T" SLOT NUTS

ARMSTRONG NUTS — ARMSTRONG WASHERS

ARMSTRONG UNIVERSAL ADJUSTABLE CLAMP — ARMSTRONG SET-UP WEDGES — ARMSTRONG "T" SLOT CLAMP



ARMSTRONG PLAIN CLAMP — ARMSTRONG SCREW HEEL CLAMP — ARMSTRONG GOOSE NECK CLAMP

ARMSTRONG DOUBLE FINGER CLAMP — ARMSTRONG FINGER CLAMP — ARMSTRONG "U" CLAMP

Whatever its shape, a work piece can be quickly, easily and safely set up on any T-slotted table with ARMSTRONG Set-up Tools. Comprising a complete "system" of supporting and holding devices in all essential sizes, ARMSTRONG Set-up Tools usually pay for themselves on the first job and continue to lower costs for years to come.

Save Time: Keep costly machines and high priced men producing—save time otherwise lost while operators rummage in the scrap box for materials with which to devise makeshift set-up methods.

Prevent Breakage and Spoilage—correctly designed, machined from special steels or drop forged and heat treated, they are extremely stiff, strong and reliable.

Increase Accuracy—hold work rigidly and support it fully regardless of shape.

Prevent Accidents—end risk of set-up failure with resulting tool breakage, damage or personal injury.

Increase Profits—by reducing down time, increasing man hour output, assuring accuracy, ARMSTRONG Set-up and Hold-down Tools cut costs and build profits. They are part of every properly equipped tool room and shop.

Your Local Armstrong Industrial Distributor carries a good stock of Set-up and Hold-down Tools. He offers you quick, efficient service on these, as well as other, quality ARMSTRONG Tools.

INDUSTRIAL DISTRIBUTORS — THE RIGHT HAND OF PRODUCTION

ARMSTRONG BROS. TOOL CO.

5213 W. ARMSTRONG AVE. • CHICAGO 46, ILL.

Now you can *speed-test* gears up to 4000 RPM

Since the accuracy of any gear test depends on how well it simulates actual operating conditions, we've developed a hypoid tester with speeds up to 4000 RPM. The higher range of speed on the No. 17A-4000 Hypoid Tester makes possible a new standard in the testing of bevel gears.

Complete testing on one machine. The No. 17A-4000 Hypoid Tester is arranged for both power and slow rolling tests. With the power test you can observe a gear's smoothness of operation, its noise characteristics, and its tooth contact pattern.

Roll test the gear and you get accurate readings of its eccentricity, tooth size, spacing, and profile.

With the No. 17A-4000 Tester you can test any right angle straight bevel, Zerol® bevel, spiral bevel and hypoid gear of any pitch and up to 20″ OD.

Pre-set backlash control. The No. 17A-4000 Tester has a new hydraulic backlash control mechanism. The control automatically duplicates your pre-set backlash value when you change the relative positions of a gear pair to simulate actual operation.

Exact duplication of settings. Indicator set-up fixtures are available for large quantity testing. With these gages you can make identical settings on a battery of machines, or get the same setting repeatedly on a single machine.

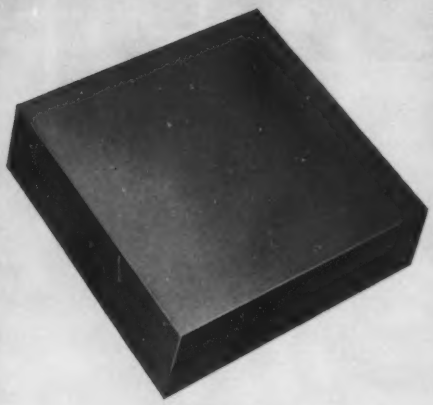
New bulletin. We've prepared a bulletin on the No. 17A-4000 Hypoid Tester to answer any questions you might have about its construction or operation. Write for a copy.

GLEASON WORKS

1000 UNIVERISTY AVE., ROCHESTER 3, N. Y.

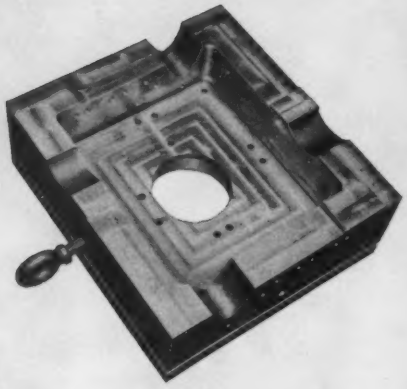
WHY BUY METAL YOU DON'T USE?

Switch to Allegheny Ludlum Cast-to-Shape Tools



FORGING

1250 lb. block, with 150 hours of machine time costing $1000, is necessary to fabricate die retainer.



CAST-TO-SHAPE

Cast-to-shape die retainer to hold automobile horn die weighs only 650 lbs., a $250 savings.

$1250 saved by changing to Cast-to-Shape tool steel

Paying for metal that ends up chips on the floor is a costly proposition these cost-conscious days. Here are two good reasons why you should switch your tool-making to Allegheny Ludlum cast-to-shape tools.

CAST-TO-SHAPE MEANS YOU BUY FEWER POUNDS OF METAL.

For example the manufacturer of automobile horns above saved 600 pounds of expensive alloy steel by specifying a cast-to-shape die retainer instead of fabricating it from a forged block. Result? A savings of $250, including the slight pattern cost.

CAST-TO-SHAPE MEANS LESS FINISH MACHINING.

To machine a retainer from the block above would have taken 150 hours of machine time at a cost of more than $1000. The Cast-to-Shape retainer is within ¼ to ⅜ inch of *finished* size, requiring only a *slight* roughing and finishing operation.

Allegheny Ludlum, a tool steel producer who makes cast-to-shape tools, casts them with the same precise quality control for which their tool steels is known. A full line of cast-to-shape tool steel grades is available. You'll find ones with high resistance to abrasion, compressive strengths of approximately 400,000 psi, easy machinability, hardening with almost no distortion, toughness, high red hardness, and the capacity to take a high polish.

Find out now how you can cut costs on your complex tools. Write for FC-4, a 28-page technical discussion of A-L's Forging and Casting Division with applications, pattern information, design tips, analyses, and heat treating instructions. Or call your nearest A-L tool steel warehouse or distributor.

ALLEGHENY LUDLUM STEEL CORPORATION, OLIVER BUILDING, PITTSBURGH 22, PENNA.
Write to Dept. M-26

7278

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country . . . Check the yellow pages

EVERY GRADE OF TOOL STEEL . . . EVERY HELP IN USING IT

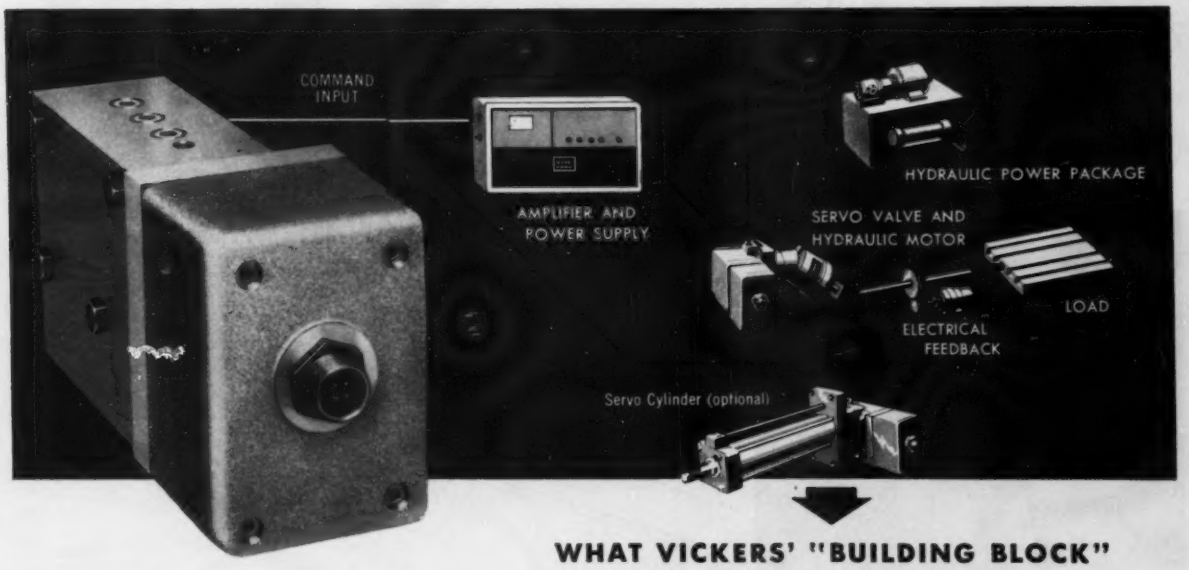
an improved VICKERS. SERVO VALVE

...yet priced 20% below previous models

FOR PRECISE CONTROL OF OIL FLOW IN INDUSTRIAL, MILITARY AND MARINE HYDRAULIC SYSTEMS WHERE HIGH RESPONSE, ACCURACY, SIMPLICITY, RUGGEDNESS AND DEPENDABILITY ARE ESSENTIAL

Input signal to this improved Vickers electro-hydraulic servo valve can originate from a simple calibrated potentiometer or a sophisticated magnetic or punched tape reader system—yet the result is always extremely precise hydraulic flow proportional to the electrical command. This valve can be applied to a broad array of machine tools, process equipment and ordnance applications and is compatible with the wide range of command input methods commercially available.

There are only four moving parts in the two-stage, spool assembly of the Vickers servo valves, thus providing a simple, contaminant tolerant, exceptionally reliable operation. Get details by writing for Bulletin 59-74.



Available in models for flows to 37 gpm and suitable for operation at pressures to 3000 *psi* with a choice of mountings.

WHAT VICKERS' "BUILDING BLOCK" CONCEPT MEANS TO YOU

These pre-engineered electro-hydraulic servo systems offer positional accuracies of ±.0015-inch; and down to ±.0005-inch using the same standard components but with additional "trim." Your cost for Vickers "Building Block" systems is far below that normally associated with this degree of accuracy and response. These systems are specifically designed for heavy duty, industrial use.

Plug-in elements make trouble shooting and maintenance easy. Vickers' worldwide service organization insures unmatched backup for your personnel when required.

Why not contact the Vickers office near you today for more facts?

TYPICAL APPLICATIONS

Controlling velocity in processing applications • controlling position of machine tool slides and tables • programmed control of work handling and machine sequencing.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1403 • Detroit 32, Michigan

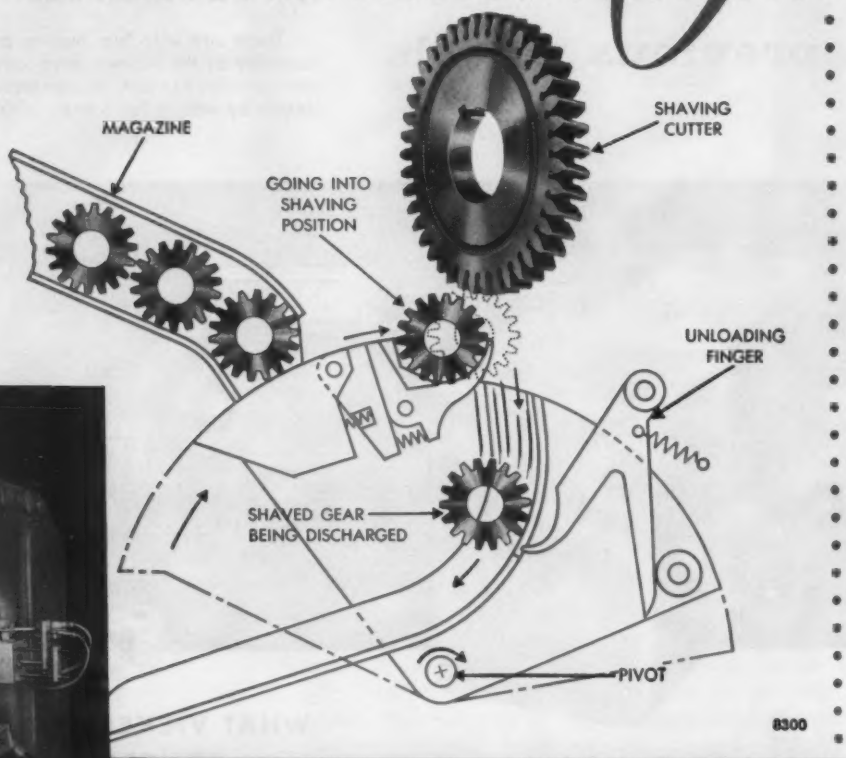
Application Engineering Offices: ATLANTA • CHICAGO AREA (Bensenville)* CINCINNATI • CLEVELAND • DETROIT* • GRAND RAPIDS • HOUSTON INDIANAPOLIS • LOS ANGELES AREA (El Segundo) • MILWAUKEE NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media) PITTSBURGH AREA (Mt. Lebanon) • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • WORCESTER
Factories also in: Australia, England, Japan and Germany
In Canada: Vickers-Sperry of Canada, Ltd., Toronto,* Montreal and Vancouver
Field Service Headquarters Underlined. Whse. Stock & Repair Branches*.

8479

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

For more data circle this page number on card at back of book

WHY SETTLE FOR ONLY 75% OF THE PRODUCTION YOU CAN GET WITH AUTOMATIC GEAR SHAVING



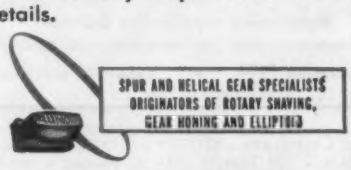
RED RING ROCKER-TYPE AUTOMATIC LOADER
(PATENTED)

Production you can expect from automated gear shaving is determined by the type of automatic loader you use.

You get maximum production when the loader moves a gear from the magazine into shaving position and discharges its shaved predecessor — **all at the same time.** This assures maximum cutter operation.

If, on the other hand, the loading of a fresh gear has to wait until the previous gear has been discharged, shaving is delayed and you get only about 75% of the production you could otherwise expect.

The standard Universal Red Ring Gear Shaving Machine may be automated for **MAXIMUM PRODUCTION** — and without any major revisions in its design. Write for details.



NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

cool · tough

DASCO SUPER SOLUBLE BASE

water-mix cutting fluid

Under adverse conditions—on jobs too difficult for regular water-mix cutting fluids, yet not suited for straight petroleum oils—Stuart's Dasco Super-Soluble Base will improve performance and profits, reduce costs.

Here is a water-mix cutting fluid with a sulfochlorinated fatty oil base that assures proper chip formation, prevents welding, and reduces heat-generating friction under extreme circumstances. It is a heavy-duty soluble oil that permits machining of stainless, low carbon steels, monel, and jet engine alloys with economical tool life and fine surface finish. Even at slow cutting speeds, the chemically active extreme pressure additive in Dasco Super-Soluble provides antiweld protection at the tool-chip interface—prevents edge build-up and cratering of tools.

Dasco Super-Soluble gives you high lubricity, antiwear, and antiweld qualities, plus the high cooling capacity inherent in a water-mix cutting fluid. It is ideal for heavy-duty turret lathe work, high-speed turning with carbides, tough form milling, boring, and surface or round-hole broaching. Use it at 40 to 1 for turning, drilling, milling, boring, sawing, and reaming—15 to 1 for broaching.

Stuart

here comes real detergency

Stuart's new Hi-D

transparent metalworking compound

Hybrid compound keeps grinding wheels open and free-cutting, minimizes machine tool maintenance.

Now, today, there is a metalworking compound that offers extra-high detergency for stress-free grinding, yet does not attack paint, remove way lubricant, or leave crystalline deposits on the machine . . . that lubricates as it cleans, yet does not leave an oil film on the chuck . . . that is just as clear as any synthetic compound, yet is a petrochemical-type solution that is effective and stable at 60:1.

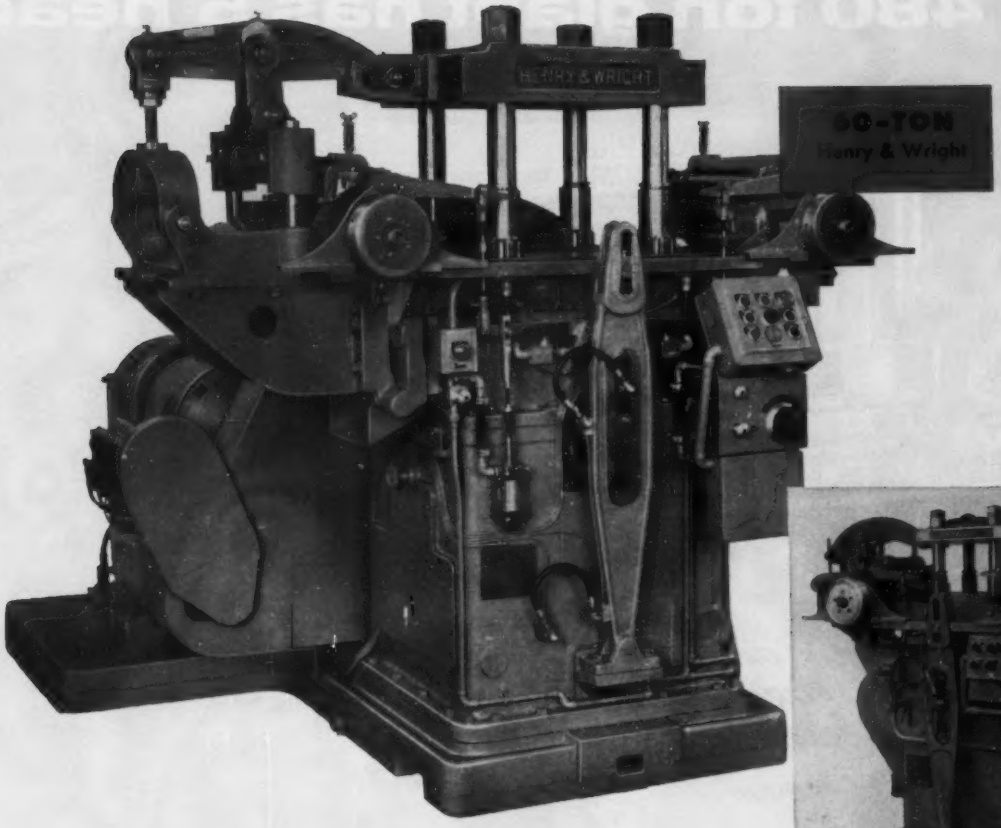
Hi-D is one of the outstanding lubrication developments in Stuart's 90-year history. Yet, it costs less per drum than most "coolants"—up to ⅓ less at proper dilution than some high-priced cutting fluids.

No other cutting and grinding compound is anything like it. Best described as a hybrid, it has all the qualities you look for in a synthetic without any of the disadvantages.

Stuart

D. A. STUART OIL CO., LIMITED
2727 South Troy Street, Chicago 23, Illinois

Canadian D. A. Stuart Oil Co., Limited, P. O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada



These Henry & Wrights Do What 5 to 10 Conventional Presses Do- *More Quickly*

Over 3000 Henry & Wright Dieing Machines in service today, attest to the popularity of one of our earliest forms of automation. They were born to the mass production industry almost before it started. Every model employs the same basic design principles. A low center of gravity with all driving elements below the die bed assures stability for high speed operation. Precision alignment is provided by the long guiding surfaces; a pulling stroke rather than a pushing force gives better control; angular thrust of crankshaft is absorbed by lower crosshead instead of by slide or punch. These and many other features assure maximum die life, at higher speeds, with more profit for you.

These high production units can replace the work of several conventional presses cutting labor costs proportionately. Modern progressive dies can produce virtually any shape, with any material, simpler and faster. Let H-P-M engineers adapt Henry & Wrights to your next mass production problem. Take advantage of less operating cost, reduced amount of floor space required, greater production output.

THE HYDRAULIC PRESS MANUFACTURING COMPANY

A Division of Koehring Company • Mount Gilead, Ohio, U.S.A.

HPM H40

For more data circle this page number on card at back of book

this 480 ton giant has 5 heads

combined planer and milling machine

No need to risk the inaccuracies that come from moving a workpiece weighing up to 100 tons from machine to machine for different operations. One set-up is all you need with this Waldrich Siegen machine. And just think of the tremendous savings in set-up time and costs.

Three milling heads take care of milling, boring and thread cutting operations; another head does planing and grinding; and there's a planer side head, too.

The Waldrich patented tool retracting mechanism in the planer head raises tool in a straight vertical plane after unclamping, repositions tool automatically, then reclamps. Cross rail is clamped hydraulically in exact horizontal position, located by separate electric drive. Built-in optics confirm accurate location.

Rigid, you bet—from top to bottom! Waldrich construction features a base plate crossing under machine and tying columns and bed into one ruggedly rigid unit. And there's a total of 900 h.p. working for you.

Write for all the specs on this mammoth producer. And ask a Waldrich engineer to discuss them in detail—in terms of your production needs.

WALDRICH
SIEGEN

american waldrich mfg. corp.

1232 PENN AVENUE, PITTSBURGH 22, PENNSYLVANIA

this 140-TON horizontal milling machine

There's never been one like it before!

Just a press of a button puts this mighty Schiess into action. A 25-ft. high column moves smoothly along 45-ft. long bedways. Never a vibration—no chatter—even at maximum transversal loads! The new Schiess design of the spindle heads has eliminated this!

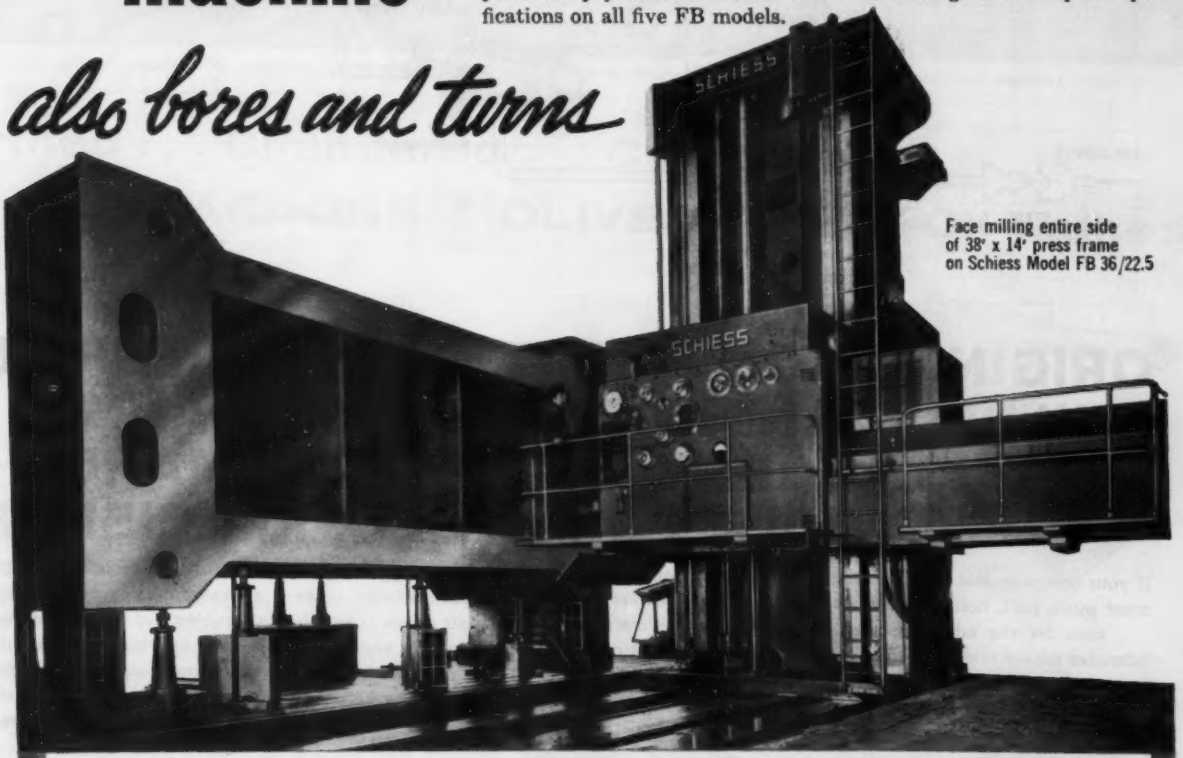
THE MILLING OPERATION. A huge tungsten-carbide cutter in a 14¼" spindle goes to work on the stock. And performs its operation with a consistent accuracy—a surface-finish count—never before obtainable on such a big fellow.

THE BORING OPERATION. Another press of a button! Another spindle goes to work—bores a 79" depth in one cut—or a total depth of 118". Boring and milling spindles are provided with 36 speeds of which the top 12 are V-belt transmitted. Rapid traverse, feeds and manual controls of the two spindles are completely independent.

That this mighty machine has tremendous productive capacity is self-evident. And its productivity goes far beyond conventional milling and boring. Schiess attachments increase its scope to taper-milling, thread-cutting, copying and, in certain instances, copying in 3 dimensions. It's a time saver, too. Can go from feed to rapid traverse immediately, without complicated adjustments.

The Schiess Model FB 36/22.5 Horizontal Milling and Boring Machine is a product of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess Engineer will be happy to help you size up these heavy producers for your heavy production needs. Write for catalogs and complete specifications on all five FB models.

also bores and turns



Face milling entire side of 38' x 14' press frame on Schiess Model FB 36/22.5

SCHIESS

AMERICAN SCHIESS CORPORATION

1232 Penn Avenue, Pittsburgh 22, Pa.

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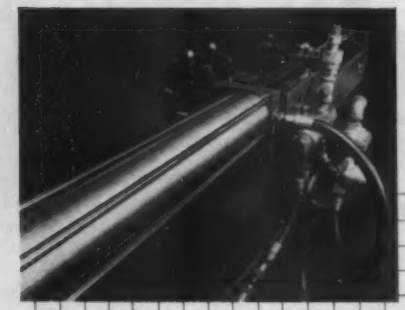
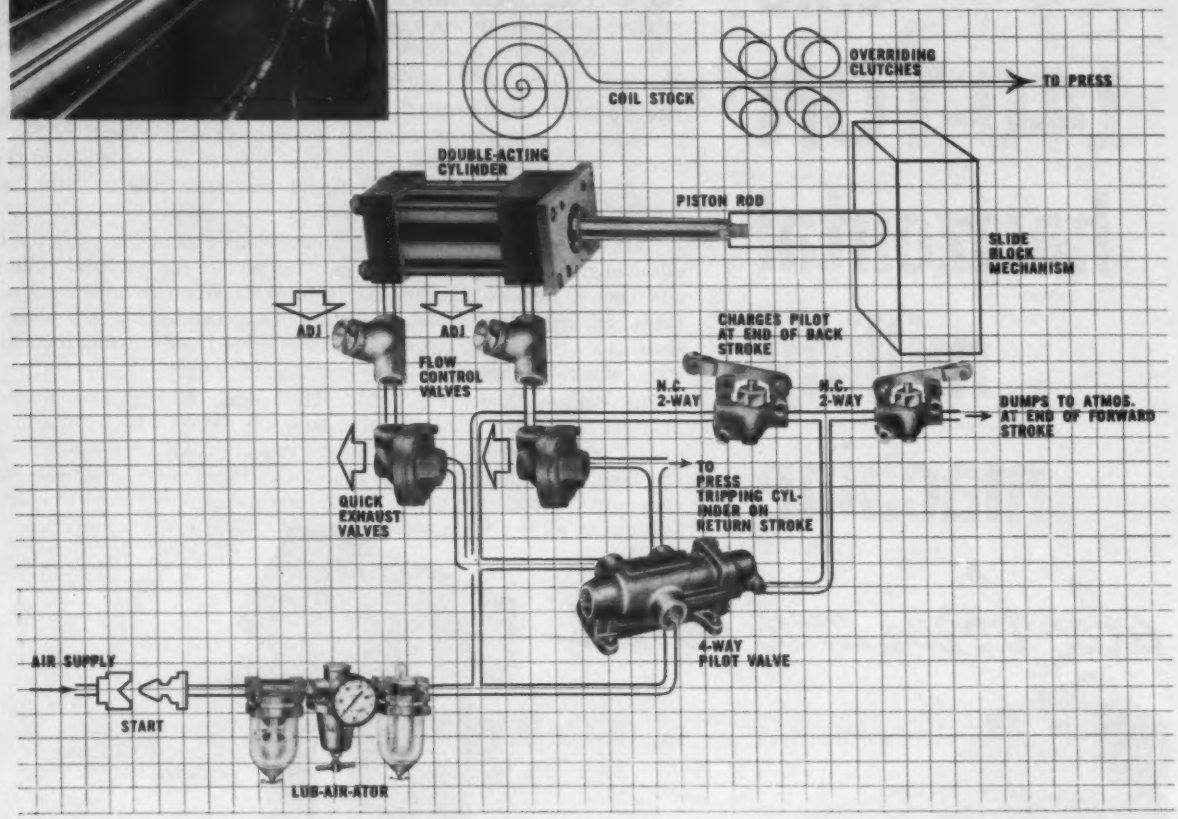


This is an example of how OEM use Schrader. The hookup of Schrader Air Products in the large schematic is used by the Cooper-Weymouth Company of Stratford, Connecticut, to operate its patented power press slide-feed. Power to the mechanism is supplied by a Schrader double-acting cylinder, the front head of which is machined as an integral part of the overriding clutch. At the end of the forward stroke, the slide block operates a normally-closed 2-way valve, which dumps the pilot of a 4-way control valve. This reverses cylinder piston, and the slide block mounted on it, to return for the next stroke. Another normally-closed 2-way valve ahead of the pilot charges the 4-way pilot in a conventional reciprocating motion arrangement to start the next cycle.



ORIGINAL EQUIPMENT MANUFACTURER BUILDS STANDARD SCHRADER AIR PRODUCTS INTO AUTOMATIC TOOLS FOR SPEED, PRECISION

If your company *manufactures* machines or equipment that must push, pull, hold, position or move work repetitively . . . consider the advantages of actuating them with air. Schrader makes complete lines of Air Products that can do such jobs with dependable precision. In limitless combinations, they adapt to many special needs.

Air offers manufacturers much more than versatility. It's fast and accurate, can time to fractions of seconds at high speeds. Its economy alone is a powerful sales point. Safe, tireless, air power is simple that problems of weight, assembly, production and maintenance are enormously reduced.

These are benefits all customers look for. Add them to your products by actuating with Schrader . . . finest, most complete lines of Air Cylinders, Valves and Accessories.

Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data write:

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

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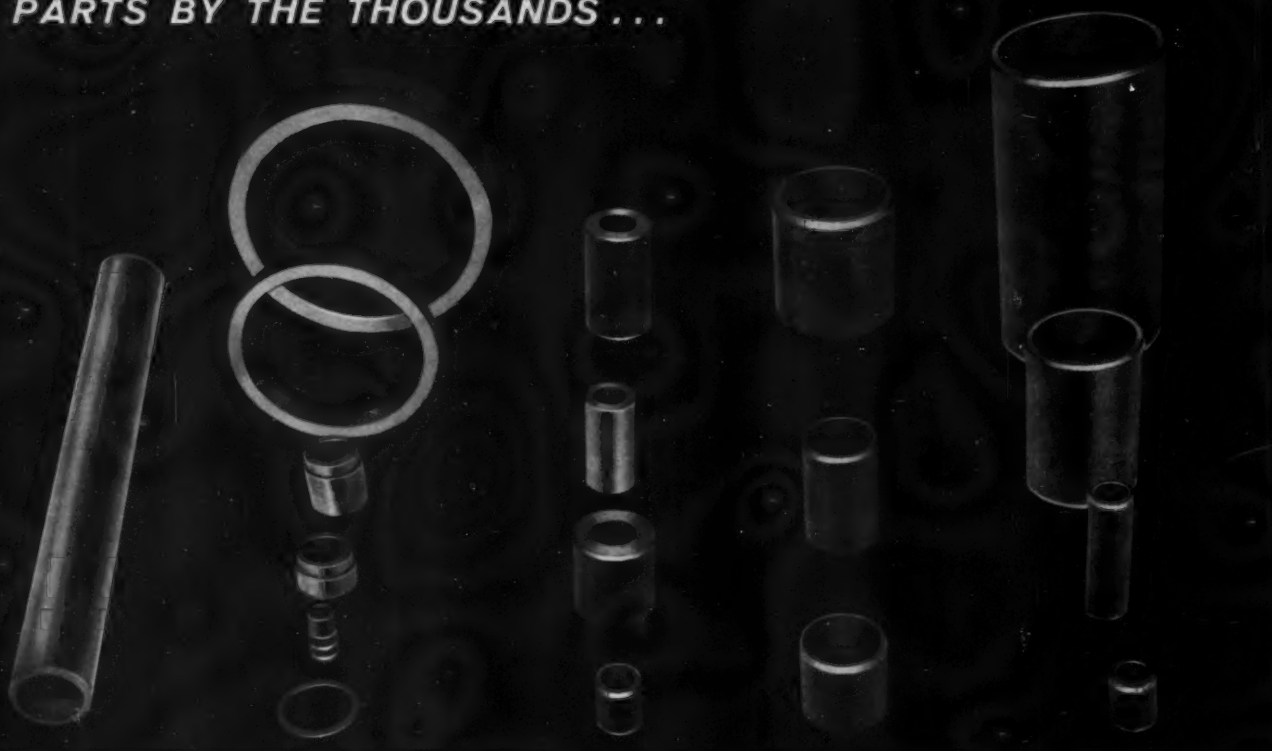
PARTS BY THE THOUSANDS . . .



Left to right: Plastic tubing, rings and formed spacers, coupling blanks, heavy pipe nipple blanks, standard pipe nipple blanks.

Formed . . . Chamfered . . . Cut-Off on BARDONS & OLIVER Cutting-Off Lathes

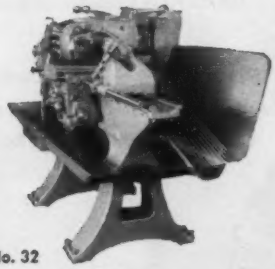
Superior Pipe Specialties Co., Chicago, reports a *ten year* profit success using Bardons & Oliver Cutting-Off Lathes.

The firm produces parts for their hydraulic equipment plus a wide variety of products on a jobbing basis.

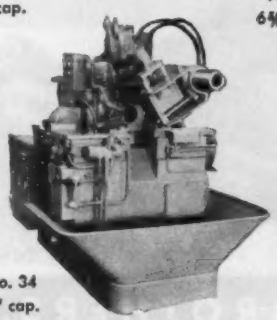
Says Mr. Youhn, Factory Superintendent: "Bardons & Oliver Cutting-Off Lathes are the *only* machines of this type that will stand up under years of hard use. We are completely satisfied with them in every respect."

As the above photograph suggests, "versatility" is the name for these Bardons & Olivers. They're unexcelled for forming, chamfering and cutting-off tubular or solid bar stock. You realize extra profits by using these outstandingly rugged machines in your plant. Available in collet capacities from 2 to 16 inches, with automatic loading and unloading equipment if desired.

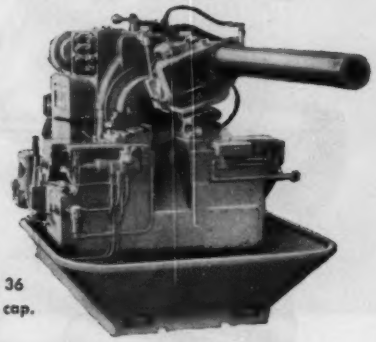
Bardons & Oliver, Inc., 1133 West 9th Street, Cleveland 13, Ohio.



No. 32
2" cap.



No. 34
4" cap.



No. 36
6⅛" cap.

OPERATING DATA FROM SUPERIOR

Typical hourly production
- No. 32 — 4000 - ½" pipe nipples chamfered & cut-off.
- No. 34 — 1082 - 2" pipe nipples chamfered & cut-off.
- No. 36 — 240 - 5" pipe nipples chamfered & cut-off.

Tolerances held on lengths: ±.002"

Average set-up time: 20 minutes

Tooling
High speed steel, carbide or roller cutter, depending on finish desired, material, operations performed and lot size.

Operators Required
2 men operate 3 machines, including setup, loading, and unloading (With automatic handling equipment 1 man can run 3 machines).

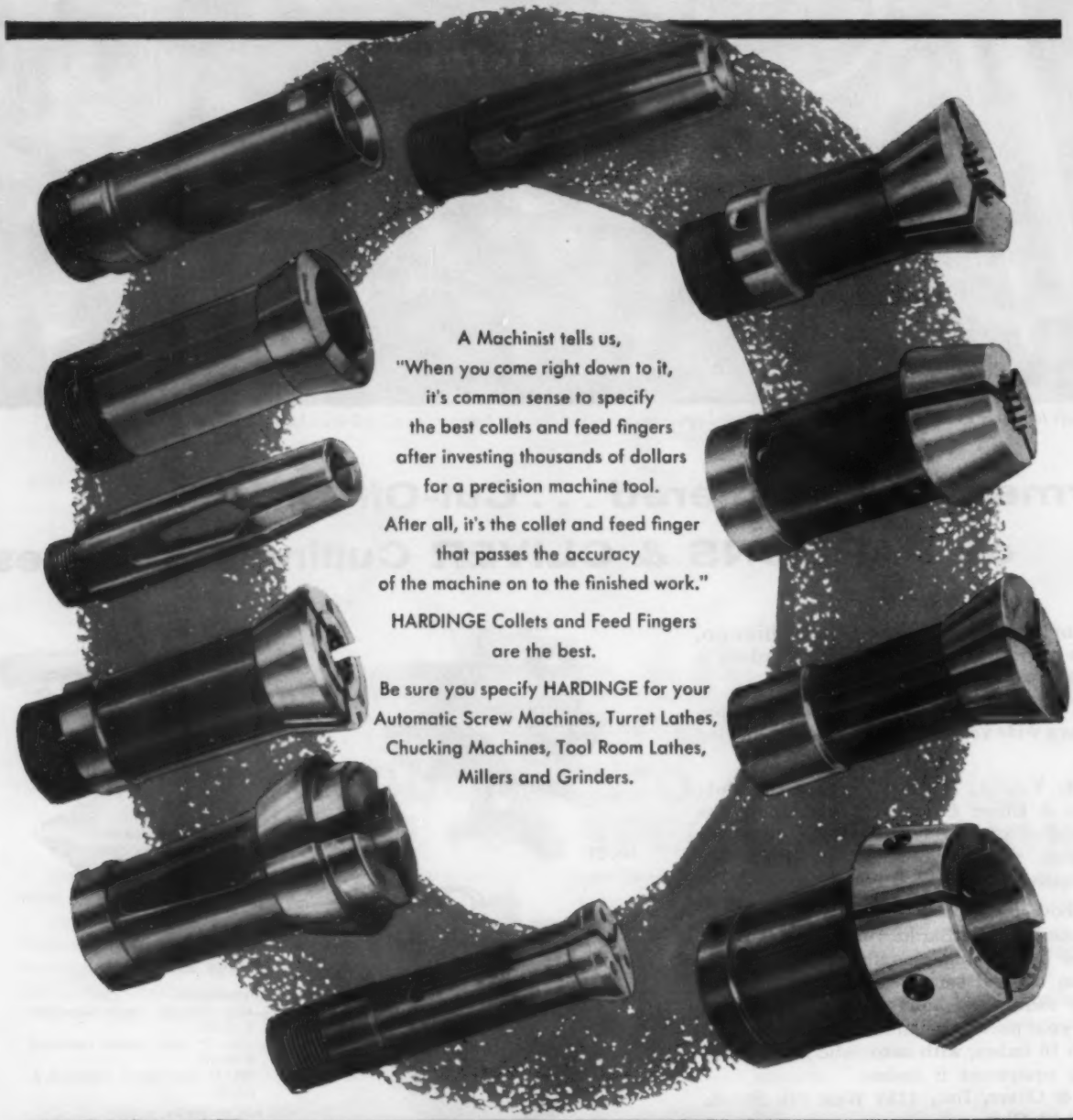
BARDONS & OLIVER

Manufacturers of Turret Lathes and Cutting-Off Lathes

Specify HARDINGE ELMIRA, N.Y.

Collets and Feed Fingers

and Get the MOST from your Investment in Machine Tools



A Machinist tells us,
"When you come right down to it,
it's common sense to specify
the best collets and feed fingers
after investing thousands of dollars
for a precision machine tool.
After all, it's the collet and feed finger
that passes the accuracy
of the machine on to the finished work."

HARDINGE Collets and Feed Fingers
are the best.

Be sure you specify HARDINGE for your
Automatic Screw Machines, Turret Lathes,
Chucking Machines, Tool Room Lathes,
Millers and Grinders.

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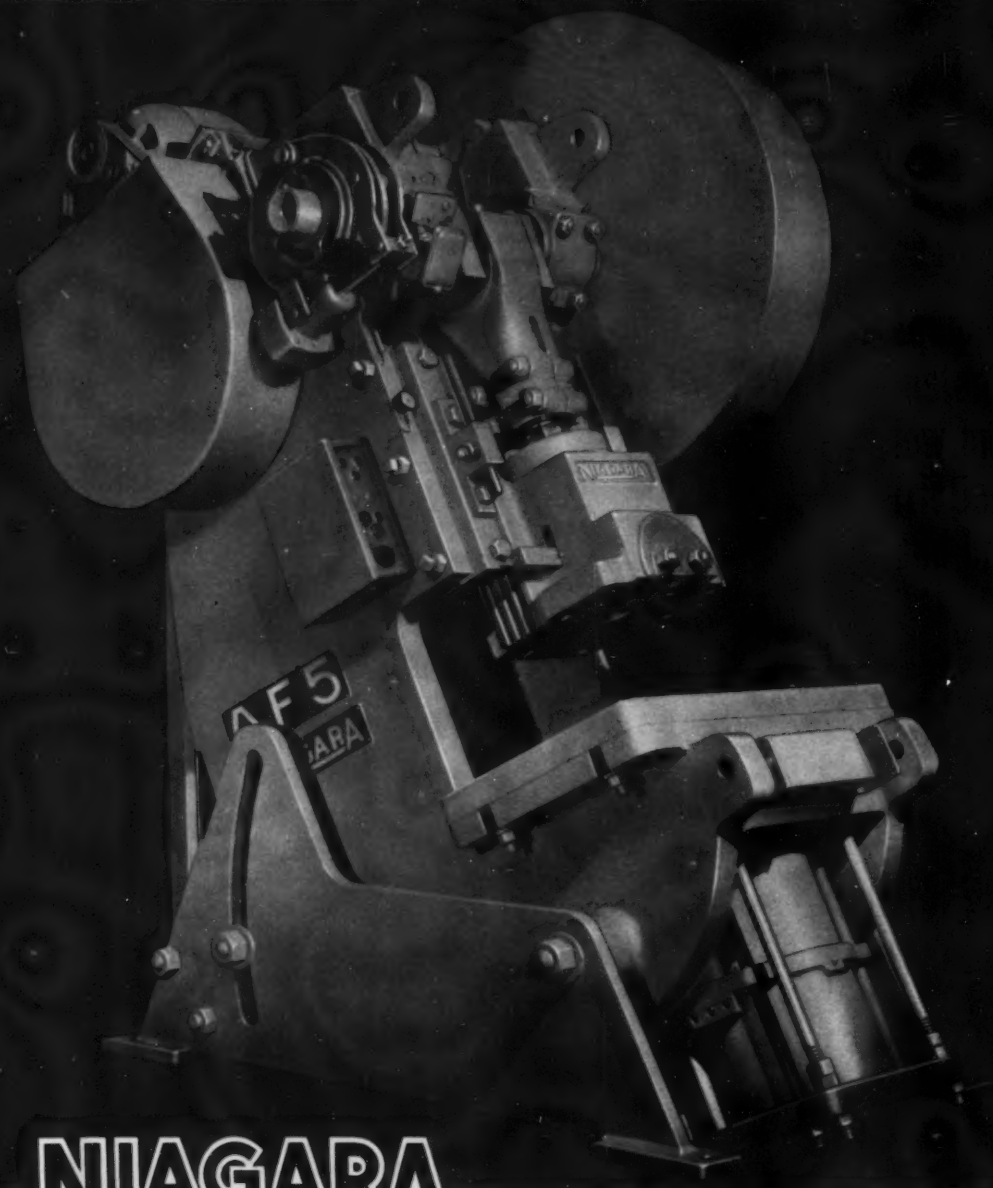

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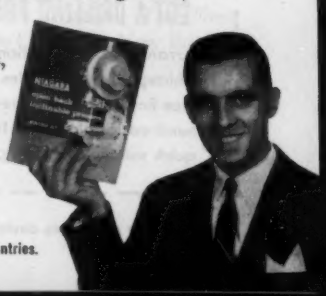

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CLIP AND FILE

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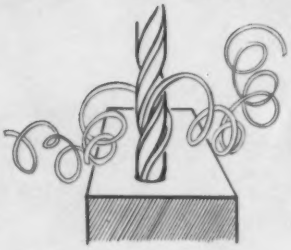
WEB THINNING IS IMPORTANT

The failure to thin the web is a common error in drill repointing. Most drills are made with webs that increase in thickness towards the shank. As the web increases, the length of the chisel edge will also increase if not thinned. Always thin the web to its original thickness, using a machine whenever possible.

NEED A CHIP BREAKER?



There is a solution to the nuisance and danger of long stringy chips — a common problem in deep hole drilling. It is Chicago-Latrobe's "LO-TORK" Chip Breaker Drill. "LO-TORK" Drills have a radically new flute contour that breaks chips, permits faster feeds, improves lubrication, and lengthens tool life.

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New Britain Cam Actuated Vertical Precision Boring Machines offer an entirely new principle for more accurate boring and turning, plus compact exterior design and fast tooling. Rough cuts and finish cuts within close tolerances on the same set-up are characteristic. Standard models are available with maximum swing from 12″ to 17¾″ in 10 or 15 horsepower.

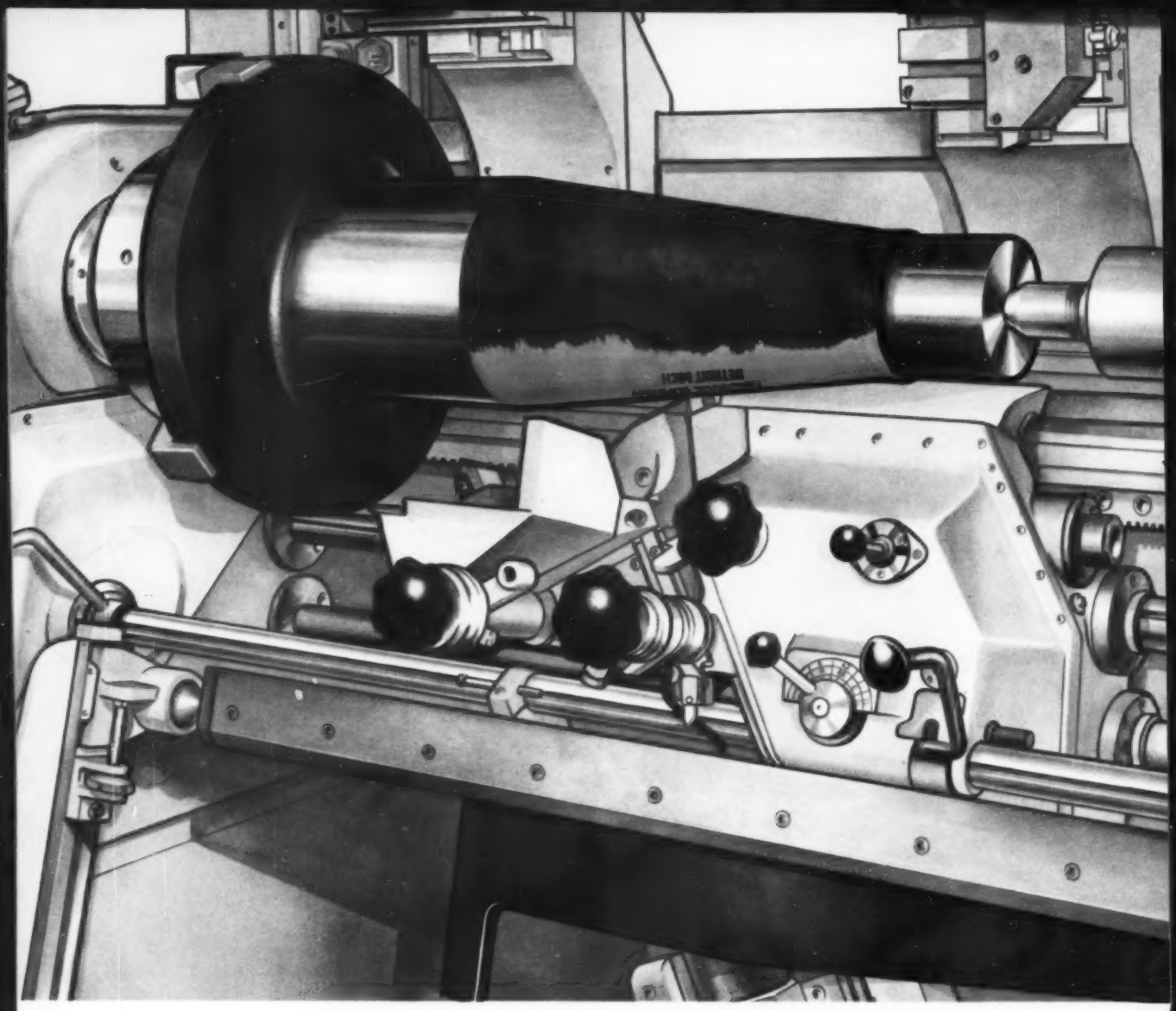
Here are a few of the major new developments incorporated in these unusual machines.

Greater accuracy. Both the vertical and cross slide cams are mounted on a common shaft which is contained inside the vertical slide. The linkages found in conventional cam-operated contouring machines are eliminated. Both the vertical and cross slides ride on preloaded roller bearings and are deflection-free.

Clean-sided design. Any number of these self-contained machines, each with one or more spindles, can be arranged side by side. Depending on how they are tooled, they operate either as a single unit or as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine, finishing both sides, completing *all* operations in one integrated, high-volume operation.

Fast tooling. Unrestricted accessibility allows rapid tool and cam changes.

Complete catalog material is available. For your copy, write New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



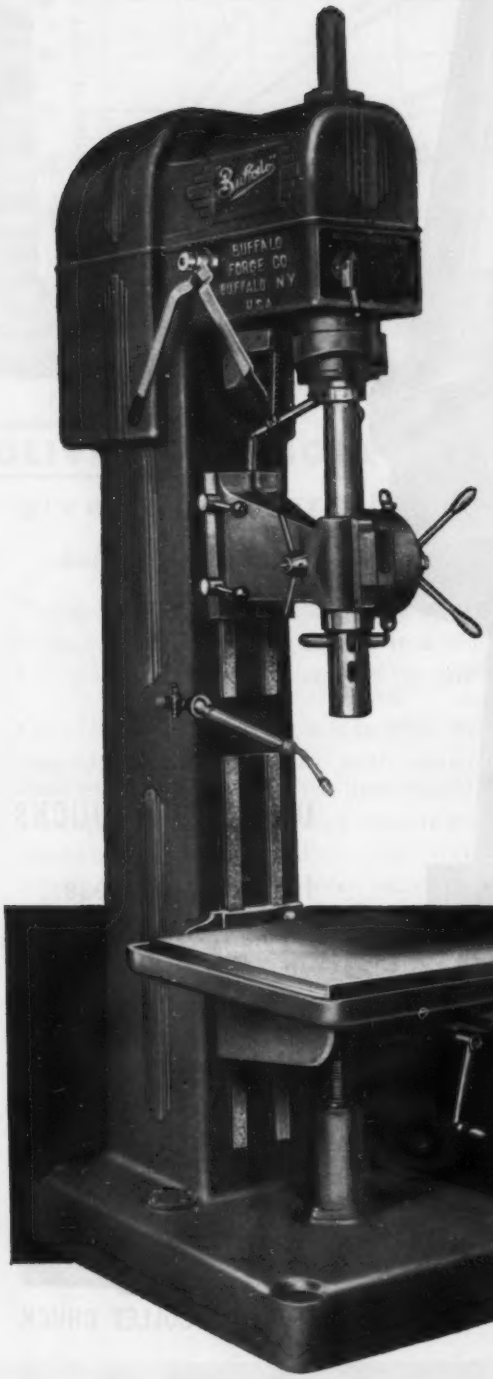
why a **copying lathe**–*why New Britain* **+GF+**

Beyond a certain point sustained production of the same piece on an engine lathe becomes uneconomical. Sometimes, however, the feeling exists that a copying lathe lacks flexibility, power and ruggedness or that it is just too "special." A New Britain **+GF+** has power–25 to 40 h.p. The **+GF+** has rugged design to handle big work and it's really flexible—a prototype or flat template will reproduce one or more pieces with fast, single point tooling. Whether it's shaft work or chucking work you have to do, ease of set-up is the same. The template or prototype can be changed in minutes. No special tooling set-ups are required, either. You can quickly switch from intricate cuts on slender shafts to heavy cuts on big castings or forgings (like the one shown). Complex profiling presents no problems even on jobs requiring really heavy metal removal.

Fast set-up and changeover from one type of work to another is only part of the story. There's much more that you'll want to know about the New Britain **+GF+**. Watching one of these machines in action is the best way to get the whole story and we'd like to arrange a demonstration for you. If you'd like to look over catalog material, we have that too, of course. Write New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

NEW

"Buffalo" No. 3A R-P-Mster with 2" Capacity and Torque-controlled Feed!



Welcome news for metalworking men! The new "Buffalo" No. 3A R-P-Mster brings you a rated capacity of 2" in mild steel.

Equally important is the exclusive "Buffalo" Torque-controlled Power Feed. With it you can safely use maximum speed and feed for the size hole being drilled. No need to worry about damage to drill or machine gearing. Danger of overloading the machine is positively eliminated by the torque control on the feed shaft.

Moderate price makes the new "Buffalo" No. 3A R-P-Mster your best variable speed drilling machine buy. All the other famous R-P-Mster features are retained — "1001" speeds, easily and quickly changed — extreme accuracy, smoothness, quietness and ease of drilling — rugged construction for long life with a minimum of maintenance. Available in 1 to 6 spindle models.

Only when you operate it yourself will you really appreciate these advantages of the "Buffalo" No. 3A R-P-Mster. Discover today how it can cut your drilling costs, increase production. Phone your "Buffalo" machine tool dealer for a demonstration, or write direct for Bulletin 3257-C.

Above: Multiple Spindle Pedestal Model
Left: Pedestal Model

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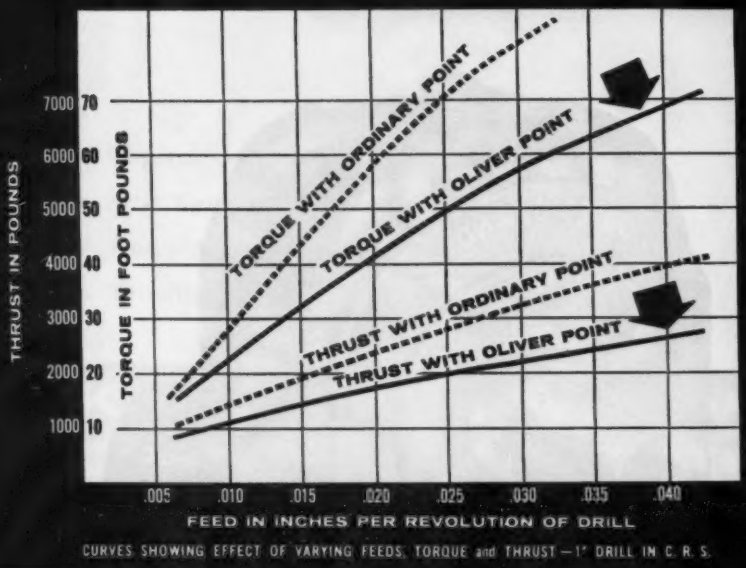


CURVES SHOWING EFFECT OF VARYING FEEDS, TORQUE and THRUST—1" DRILL IN C. R. S.

OLIVER'S UNIQUE DRILL POINTER

gives you more holes per grind

Substantially less torque—much less thrust!

The above graph is a typical test run by the research department of an eastern engineering school. It is evidence that Oliver can help you get more and better holes per grind.

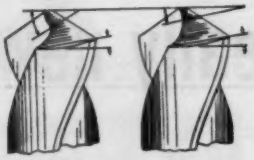
Oliver's sharpening principle is to grind the drill point so that increased clearance is obtained at the center of the drill. Each lip does its equal share and the theoretically perfect point permits easier penetration. Less feeding pressure means savings on drilling machine repairs, power and transmission costs and the drills themselves. *The Oliver point has been successfully used since 1921.*

Oliver drill pointers are rugged enough to stand up to every day pounding. Features of the Model #510 include: a universal chucking head which holds drills from ¼ to 3 inches in diameter and swivels to give varying angles from 82 to 160°; an adjustable cam to give a variable amount of clearance at the cutting edge; and a positive drive to the chuck. In addition, all main shafts—including the grinding wheel spindle—are mounted on anti-friction bearings.

Want proof? Oliver will sharpen *your* drills on a "no-charge" trial basis. Write today for full information. We'd like the opportunity of sending a quotation.

HOW TO REDUCE YOUR TWIST DRILL COSTS

Any substantial reduction in drill costs must be made by choosing a combination of the right drill design *and drill point.*



The sketch above shows a comparison of two drill points. The one on the right is as ordinarily ground. On the left is an exaggerated view of an Oliver drill point. Note that the clearance angle on the point increases very rapidly as the drill web is approached.

It is a widely accepted fact that for a given feed the angle of helix of the feed is greater as it approaches the center. It is this reason that makes increased clearance at the center of the drill point so essential. The Oliver pointers provide average thrust reductions of 25.2% and average torque reductions of 22.0%.

The Oliver 510 makes possible the trouble free grinding of drills—whether 2, 3 or 4 flute. Variable included point angles and clearances are easily obtained.

This cost-saving point is also available by using the new heavy-duty #21 bench model machine. Capacity is

3/32" to ½". A 5" diameter cup wheel and a built-in diamond dresser provides for easy operation regardless of drill size or included angle.

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It was Designed to Provide: High Horsepower in a Smaller Unit • Centrifugally Cast Bronze Gears • Alloy Steel Worms Heat Treated By An Exclusive Process for Carrying Higher Loads • Fan Cooling for More Efficient Operation • Maximum Overhung Load-Carrying Capacity • Ribbed Housing for Maximum Strength and Heat Dissipation • Modern, Streamlined Design to Enhance Your Machine's Appearance.

Cleveland's new speed reducer line meets AGMA Standard 440.03 — which permits higher horsepower and torque ratings — provides you speed reduction at savings of 50% or more on cost per horsepower. All this, with no deviation from Cleveland's standards of quality and dependability.

Remember, this strikingly new line of fan-cooled reducers — now available from one to forty horsepower — incorporates all the design knowledge gained by Cleveland's engineers over the past 47 years — plus all the advantages of modern metallurgical techniques and advanced manufacturing processes. Consult your Cleveland Representative for the complete story on this new speed reducer — or write us direct for Bulletin No. 405. It details input horsepower and output torque ratings, service factors, application and load classifications, as well as general over-all dimensions. **The Cleveland Worm & Gear Company, 3276 East 80th Street, Cleveland 4, Ohio.**

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Worm Gear
Speed Reducers

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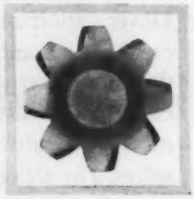
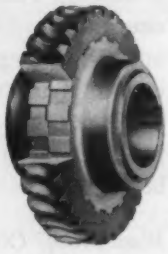


Cleveland's Worm's, heat-treated by an exclusive process, possess a high degree of hardness throughout their entire thread thickness — and well below the worm's root diameter. This gives maximum thread strength and resistance to wear without losing the advantage of a tough core of medium hardness.



Centrifugal cast bronze rims have a greater density and a higher hardness, giving increased resistance to wear and fatigue pitting. They are centrifugally cast integral with cast iron centers on 6" and smaller sizes. This permits strong mechanical keying of the two parts — without dependence on actual surface bond. Gear shaft extension diameters are especially large to permit greatly increased overhung load capacity.

Worm and gear shaft bearings are Timken taper roller type, providing adequate thrust and radial capacity. Worm bearings are mounted directly in the housing bore for greater rigidity.

- **Capital Goods Triple Play Cited**
- **First Quarter Outlay to Rise 5 Per Cent**
- **General Tax Reduction Unlikely**
- **Washington Briefs**

Keeping up with Washington

Loring F. Overman

A TRIPLE PLAY in the capital-goods field is called to the attention of users, manufacturers, and the Government by the Machinery and Allied Products Institute. Based on studies of the rapid accumulation during the last five years of upper-aged capital equipment, MAPI points out that:

1. Expenditures for modernization and replacement will continue to represent both a substantial and growing part of the capital-goods market.

2. To the extent that this is true, any plans to increase the economic growth rate of this country must take into account not only investment for expansion but enlarged expenditures for replacement needs as well.

These conditions suggest a three-way responsibility and opportunity—for users, problems of expansion, replacement, and cost reduction—for manufacturers of capital goods, an important marketing opportunity—for Government, the need to encourage an economic climate favorable to the development and maintenance of a modern and productive plant. This can be achieved, MAPI points out, only if realistic policies are adopted with respect to corporate taxes, depreciation allowances, and retained earnings which will permit business to accumulate a supply of capital that will be sufficient to carry out its objectives.

First Quarter Outlay to Rise 5 Per Cent

Reflecting MAPI's forecast of the need for capital-goods modernization and replacement, the Commerce Department and Securities and Exchange Commission anticipate that capital spending during the first three months of 1960 will be 5 per cent above the quarterly average for 1959.

For 1959 as a whole, spending was expected to total $32,700,000,000, ahead of 1958 by 7 per cent. A $33,300,000,000 total had been expected prior to the steel strike. During the January-March quarter of 1960, capital spending at the annual rate of $34,400,000,000 is expected.

General Tax Reduction Unlikely

Despite five weeks of hearings involving thirty-one panels and 175 spokesmen, there is little likelihood of a general income tax reduction in 1960. Authority for this disappointing news is Chairman Wilbur D. Mills, (D-Ark.), of the House Ways and Means Committee.

Chairman Mills explained that months will be required for staffs of the committee and the Internal Revenue Service to analyze the testimony and make recommendations. In this, an election year, members of the second session of the 86th Congress can be expected to limit their deliberations to "must" legislation. Quick action on such proposals, then an early departure for home and electioneering are the procedures likely.

Viewpoints on taxes were voiced by George Terborgh of the Machinery and Allied Products Institute. In urging liberalization of the tax-depreciation policy as a means of speeding up growth of the American economy, Mr. Terborgh said: "Our growth rate over the past decade has lagged behind not only that of the Soviet Union but also that of the leading industrial competitors in the Free World. Many of the latter are far ahead of us in liberalizing tax-depreciation write-offs, and their economies reflect the advantages of the heavier capital investment that such liberalization brings about."

Washington Briefs

To assist in coordinating Federal procurement policies, a new five-agency Procurement Policy Board has been authorized. The board will function under the direction of an Office of Procurement Policy, and will involve the General Services Administration, Defense Department, Small Business Administration, Department of Agriculture, and Atomic Energy Commission.

Each day brings to Washington some new evidence of the changes that can be wrought in production methods and in the machinery and equipment field by the new scientific age. A recent example is a pipeline company's application to experiment with a jet aircraft engine as a source of power in the operation of a natural-gas compressor. If successful, a 12-ton jet-plane engine and power turbine hookup to produce 10,500 hp. would replace a 356-ton combination of three conventional gas engines producing the same horsepower.

The Boggs Bill (H. R. 5), proposing tax incentives to stimulate American investment in foreign countries, was favored by panelists appearing before the House Ways and Means Committee during the five-week hearing on tax revision suggestions. Some machinery interests have favored the bill as providing a means to ease taxation of income on foreign investments.

Shipments of large, low-speed diesel engines increased by 50 per cent over 1958 during 1959, and a further increase of 20 per cent is in sight for 1960. Forecaster is the Business and Defense Services Administration.

Equipment designers considering the use of gas-lubricated bearings will find valuable information in an Air Force report just made available to industry. The report, PB 151946 "Gas-Lubricated Bearings—a Critical Survey," may be ordered from the Office of Technical Services, Washington 25, D. C., at $4 per copy.

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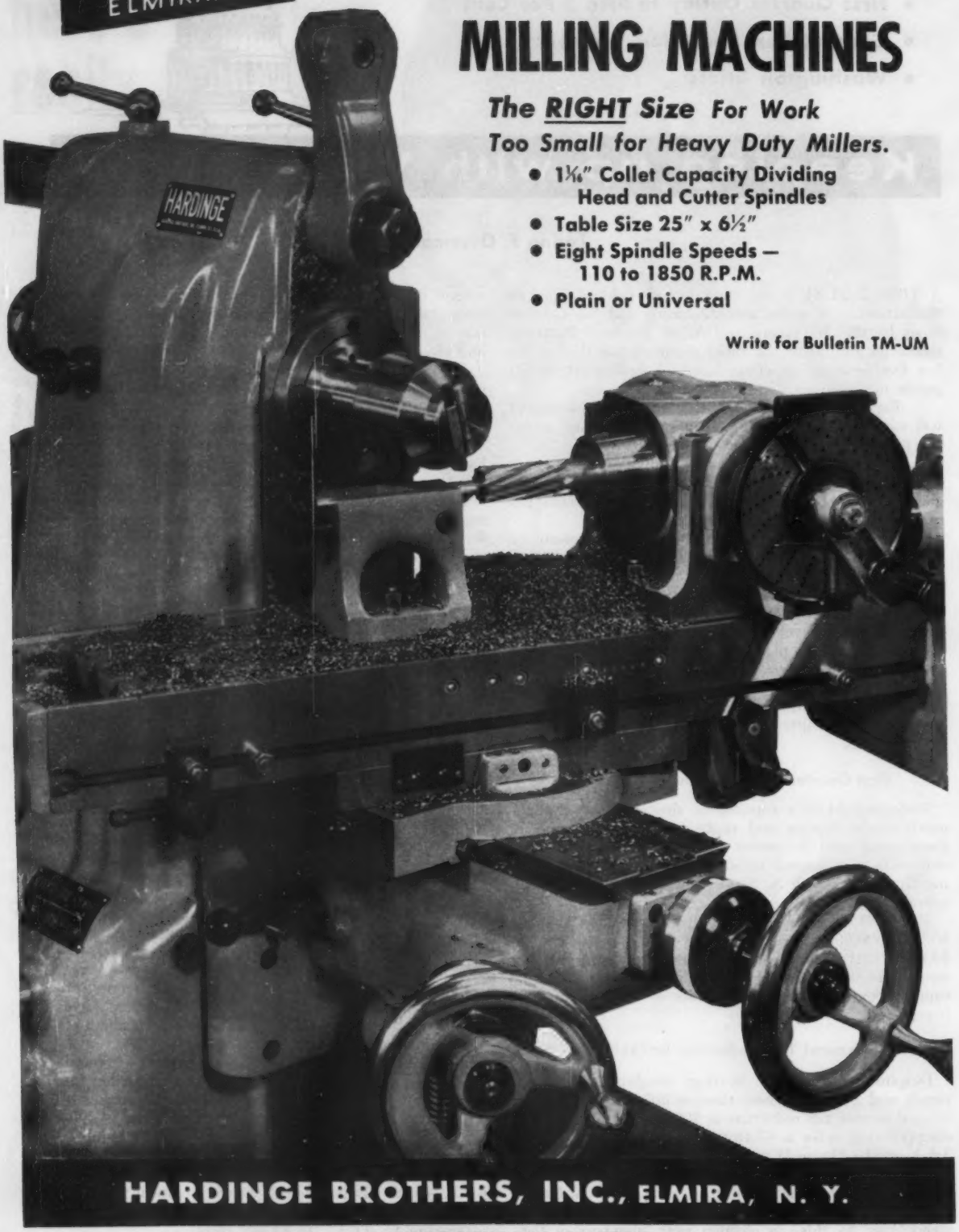


HARDINGE BROTHERS, INC., ELMIRA, N. Y.

OFFICES IN PRINCIPAL CITIES. EXPORT OFFICE 269 LAFAYETTE ST., NEW YORK 12, N.Y.

Machinery
FEBRUARY 1960

Progress on Parade

THE BIGGEST EVENT of interest to the metalworking industry in 1960 will undoubtedly be the exposition to be sponsored by the National Machine Tool Builders' Association. It will be held at the International Amphitheatre in Chicago from September 6 through 16.

The total floor area of the Exposition will be approximately 12 acres and the actual exhibit space, 7 acres. The 1955 Exposition had a total floor area of somewhat less than 10 acres. The increased space has been made available by constructing an additional hall.

All machine tool exhibits will be on the main floor level in a continuous arrangement, giving the impression of a huge machine shop. There will be nothing to obstruct the view except the machines themselves. All of these will be the latest design of American machine tools. Practically every machine will be in actual operation.

Setting up over 1000 machine tools of all conceivable types will constitute a Herculean job. At least 200 freight cars and 1500 trucks will have to be unloaded. Setting up the machines will require the services of over 250 electricians, 300 machinery movers, 75 plumbers and 50 maintenance men. Approximately 100 carpenters will be needed for constructing the display booths.

The upper North Hall, which housed machine tool exhibits in 1955, will be used for the displays of technical publications, oil companies, and other concerns that serve the metalworking industries, as well as for expanded restaurant facilities.

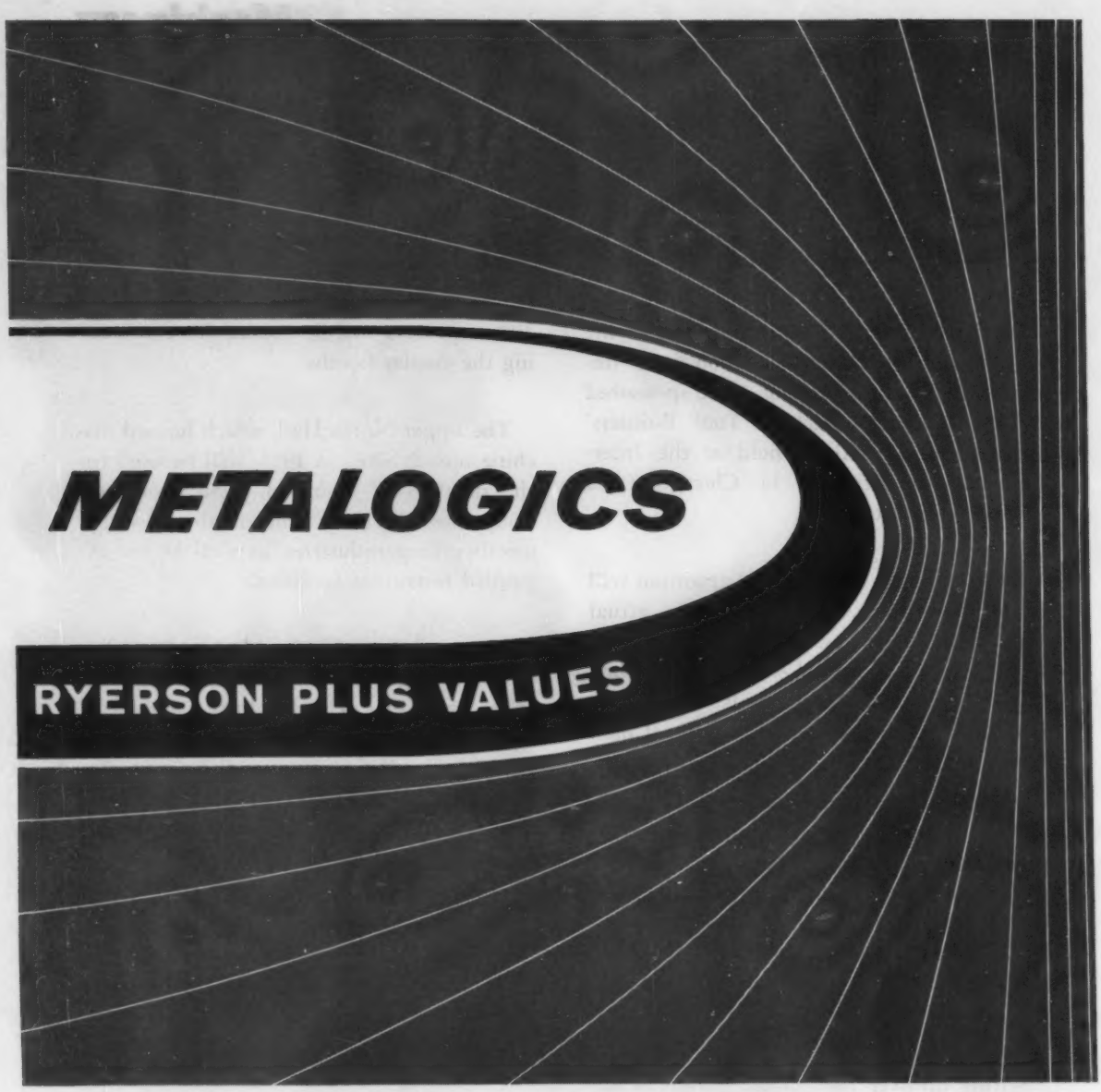
Concurrently with "The Machine Tool Exposition—1960," there will be another exhibit at the Navy Pier. This Production Engineering Show will consist of mechanisms, instruments, and other equipment and accessories applicable to machine tools. Shuttle buses will provide convenient transportation between the two exhibitions.

Attendance at the shows is expected to exceed 125,000 persons. Visitors will be chiefly top executives of manufacturing companies, production experts, and other company personnel concerned with increased productivity and product quality.

Executives in such categories in all branches of the metalworking industry should plan to be in Chicago during the two weeks beginning with Labor Day. Veritably, there they will see "Progress on Parade!"

Charles O. Herb

EDITOR



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Automatic Methods Play Big Role in Hydra-Matic Torus Fabrication

RAYMOND H. SPIOTTA, Associate Editor

AUTOMATIC UNITS are capturing a larger and larger share of the transmission market in this country as the years roll by. Not too long ago, a prospective purchaser would have to place a special order for this optional equipment. Today, the trend is rapidly reversing—the once-standard manual gear shift and clutch drive is not always readily available in local showrooms.

To keep pace with current demands, the Detroit Transmission Division of the General Motors Corporation in Ypsilanti, Mich., is placing much emphasis on fully automatic and semi-automatic production methods for turning out the familiar Dual-Range and the later controlled-coupling Hydra-Matic transmissions. Processing of the main fluid-coupling torus is an example of the company's planning along these lines. From initial forming to final balancing, production of

Production of torus units for Hydra-Matic transmissions is done on a highly automatic scale. Transfer presses for the shells head the line, while assembly is carried out on a large transfer machine. Even balancing, counterweight adding, and rechecking are automatic

these intricate sub-assemblies is handled on a predominantly automatic basis.

Torus Shells Start Out on Transfer Press

Shells for the torus sub-assembly are formed on the 800-ton Verson Transmit press shown in Fig. 1. Coils of SAE 1010 steel, 14 1/4 inches wide by 0.081 inch thick, are placed in a Littell combination cradle and straightener. The stock leaves the straightener and passes through a Littell roll-feed unit mounted on the entrance side of the press.

An eight-station die, Fig. 2, is used to complete the shells. Of these, seven stations are active and one is idle. In the first station, notches are cut into the edges of the stock strip to rough out the shape of the blank. The metal is fed to the second station where the individual blank is severed from the main stock strip and undergoes an initial drawing operation.

From this point on, automatic transfer fingers, such as those indicated at *A*, grip the work-pieces and move them through the entire sequence of press operations. There are several advantages to this type of part transfer such as a reduction of friction within the die area due to the elimination of carrying strips. Another advantage, but one that is not quite so apparent, is that annealing between draws is not necessary. This is so because the operations are so close together that the work is not given an opportunity to cool.

At the third station, the shells are given a second draw during which metal is gathered at the center, or hub *B*. The next step restrikes the crown area surrounding the hub. In Station No. 5 the hub of the torus shell is given a restrike.

Station No. 6 is an idle location. After being positioned at the seventh station, two 0.250-diameter locating holes are pierced and a large center hole—3.870 inches plus 0.005 minus 0.000 inch in diameter—is punched out. Rough trimming of a

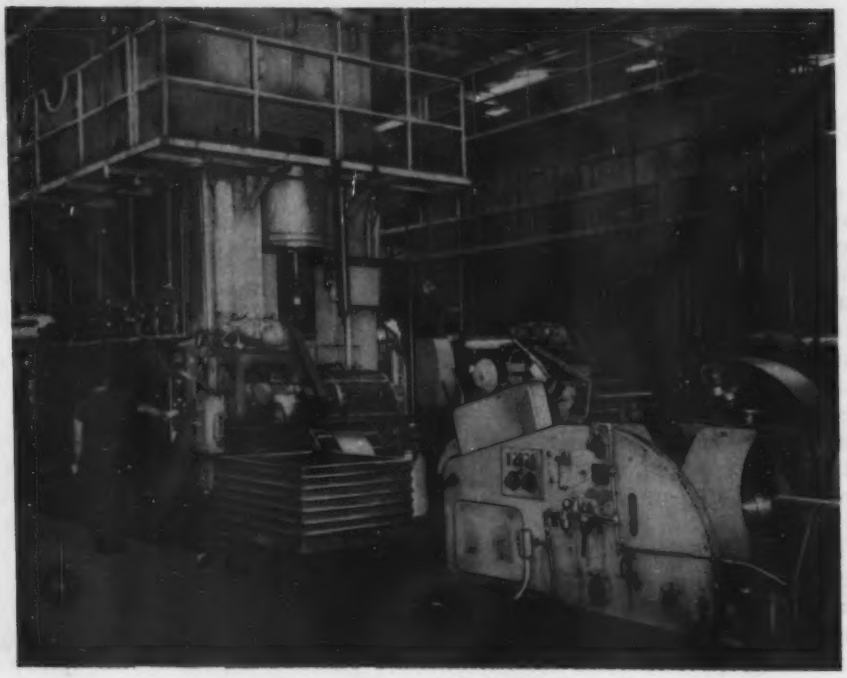

Fig. 1. This 800-ton transfer press is used to form shells for torus sub-assemblies. The press is fed from coiled steel, 0.081 inch thick, which first passes through straightening rolls.

Fig. 2. Shells are carried by transfer fingers through this eight-station die. The strip is first notched, then cut off and drawn. Additional draws and a piercing operation follow.

flange around the periphery of the shell and a last restriking is done at the eighth and final station. Transfer fingers then carry the part clear of the press and drop it on a moving-belt conveyor leading through an International washing installation.

Cleaned shells continue their travel to a bank of four 40-ton V & O notching machines. Parts are lifted from the belt, which passes between two pairs of the presses, and are placed on an expanding arbor that grips the inside of the large center hole. Positive location is assured by two pins that enter the two small holes in the shell.

Two rows of slots are required (heading illustration). The rows are on different planes and the slots, themselves, are unevenly spaced. With each strike of the press, four slots are punched—two opposing slots in each row. During each up stroke of the press ram the torus shell is indexed to the next position. Eighteen such movements take place, yielding a total of seventy-two slots. Although the working drawing specifies that the angular relationship between the slots be maintained within 5 minutes of arc, they are actually held within 1 minute of arc. After the final press stroke, a pair of lifting fingers beneath the part pivots upward and outward, allowing it to slide down a chute and onto another moving belt.

Final installation in this line is a 150-ton Model trimming press tooled up with a shimmy die. The shells are elevated to the work area on an inclined belt and drop into a loading position outside the press. A hydraulic cylinder then advances the part into the shimmy die for the trimming operation. Following this, they are automatically ejected onto a central conveyor belt and carried clear of the area.

Vane Loading Can Be Likened to an Oversized Stapling Operation

Many interesting assembly steps are performed on the torus. In the first of these, thirty-six vanes are positioned within the shell. This is done on a bank of eight automatic vane-loading machines, one of which is shown in Fig. 3. The machines were designed and built by the Process Development Section at the General Motors Technical Center.

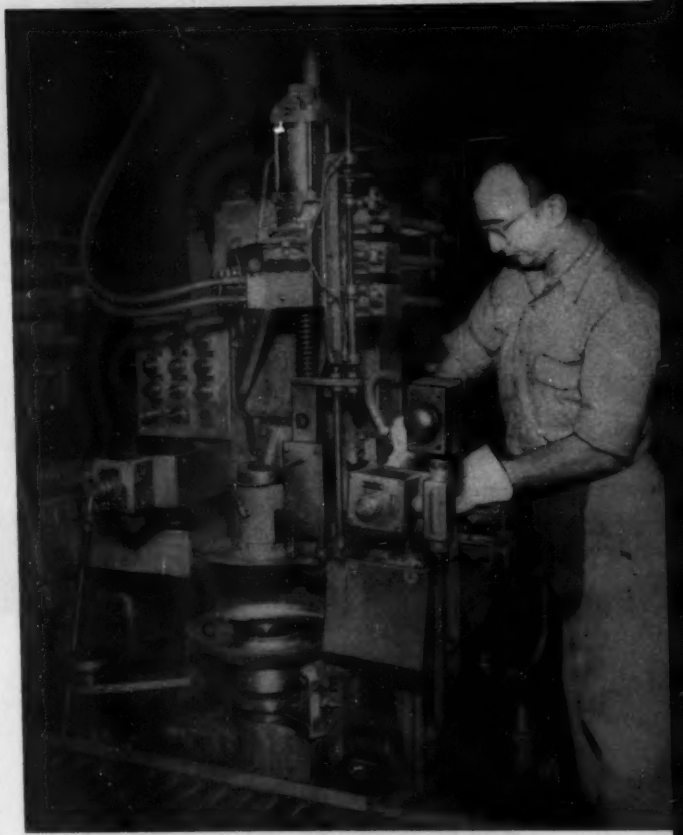

Fig. 3. Automatic machine loads vanes into torus shells. In an action similar to that of a stapling machine, the ram (D) slides one vane at a time from a magazine at the right and inserts it in the shell (C).

Stampings *C* are placed by hand on an arbor

Fig. 4. First phase of final torus assembly at head of main transfer machine. A torus vane ring is being placed on top of a shell and vane assembly that is supported on a pallet.

and located by two dowel pins. Vanes are contained in magazines that hold approximately 475 parts. The magazines, in turn, are stacked on the right-hand side of the machine and feed out beneath an air-operated ram *D*. Action of the machine is much like that of a stapler. The ram descends, contacts the first vane, and pushes it downward out of the magazine and into the concave area of the torus shell. Two tabs on the bottom edge of the vane pass through the slots, thus assuring proper positioning. These tabs are locked in place during a later operation.

After each vane is placed, the work must be repositioned to bring the next pair of slots in line with the ram. Although the slots are unevenly spaced around the shell, indexing is accomplished in an efficient and simple manner. A finger protruding from the upper end of arm *E* moves along the underside of the shell. When the end of this finger reaches a slot it pops up into it. This causes the arm to reverse its direction of travel, pulling the shell along with it. Movement is stopped when the end of the finger—that is, the slot—is in proper position. As the vane is pushed into place, the tab passes through the slot and disengages the index finger, thus initiating the next cycle.

Main Torus Assembly is Completed on Transfer Machine

Of the eight vane-loading machines, four feed each of two main assembly lines. Actually, these

Fig. 5. Control panel on the first side of the main assembly machine can be seen. Movement between stations is accomplished by a long transfer bar having keys that engage the pallets.

Fig. 6. Following drilling, the rivet holes are deburred. The tools deburr the top of the holes on the down stroke, and the bottom of the holes on the up stroke.

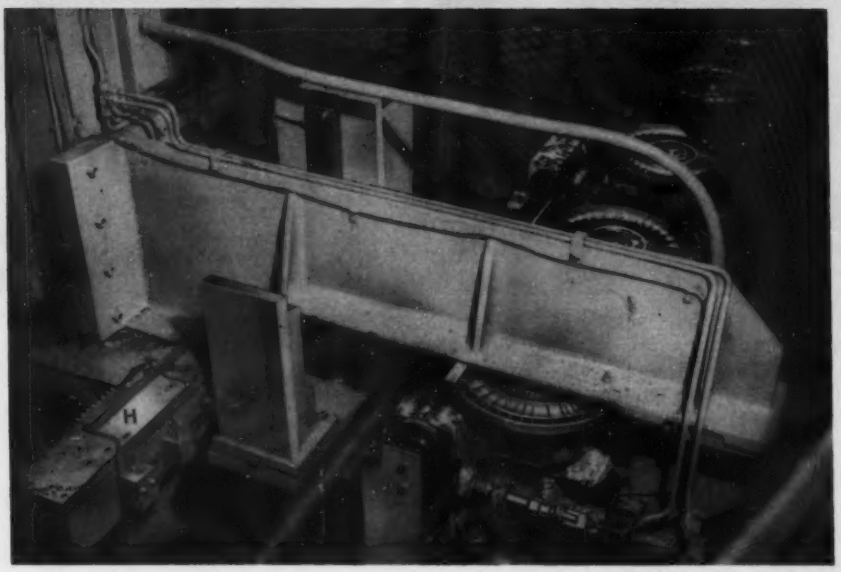

Fig. 7. When the pallets reach one end of the hairpin-shaped assembly machine they are transferred to the return side by this rack-and-pinion-driven swinging arm.

lines are transfer type machines built by the Research Division at the General Motors Technical Center. Seventy-two pallets travel around the hairpin machine layout, at the end of which the torus emerges fully assembled and inspected.

Preliminary manual assembly takes place at the beginning of the line. First, a machined carrier casting (that will eventually house four pinion gears) is placed on a pallet that slides along a stationary circular rail. The carrier is located on two dowel pins of different diameters to be sure of positive positioning. A shuttle type transfer bar, having a key that contacts the rear of the pallet, advances it to the next working position. During its return stroke the transfer bar pivots back out of contact with the pallet.

An operator picks up a shell and vane subassembly from a storage area *F*, Fig. 4, in front of the vane-loaders and places it on the pallet, on top of the carrier casting. This unit is also located on the two pallet pins. Next, a spacer is added to maintain proper relationship between the inner ends of the vanes. This is followed by a circular, U-shaped torus vane ring *G* that gives final positioning to the still loose-fitting vanes. To be sure that the vane ring is fully seated, it is lightly tapped with a wooden mallet.

From this point on, the pallets begin their travel along the automatic portion of the assembly line, Fig. 5. A drilling station is the first encountered. Mounted on an Ex-Cell-O drive unit is a U. S. multiple-spindle drill head carrying eight 15/64-inch-diameter drills. These pass through the spacer, carrier, and shell to provide

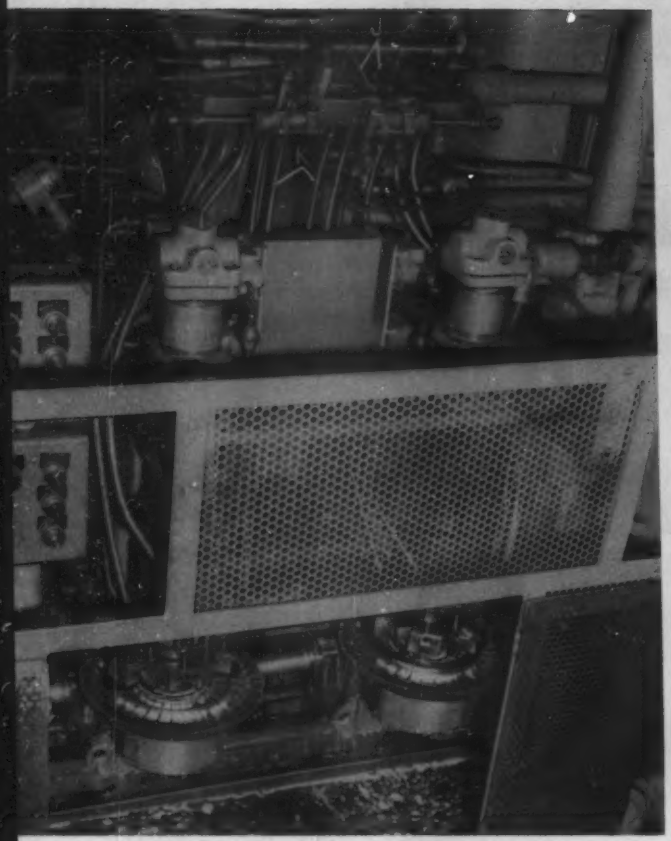

Fig. 8. Rivets are added at these two heads, each inserting four alternate fasteners. The rivets travel from a common hopper (not shown), down individual feed tubes (K), and drop between positioning fingers.

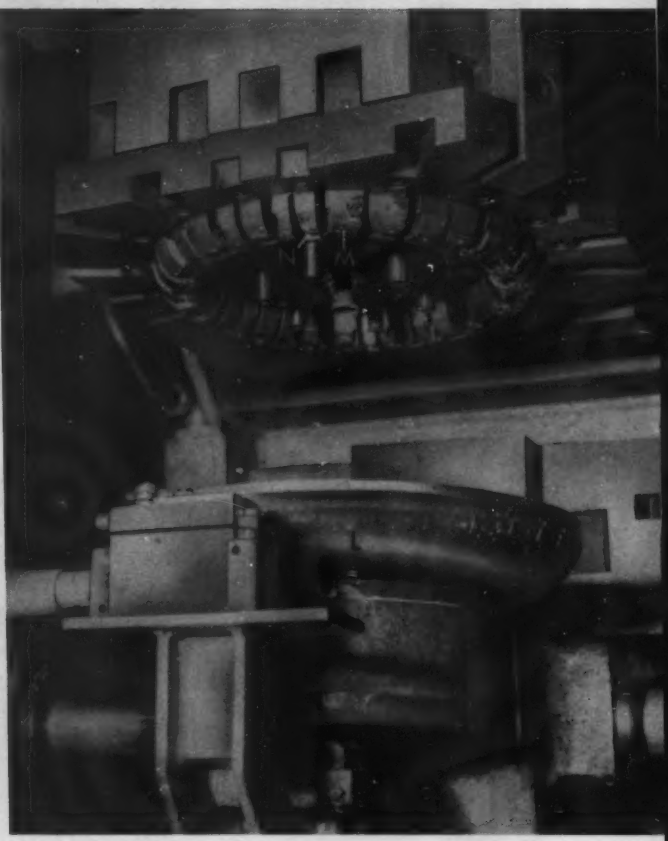

Fig. 9. At this station the torus vane ring is locked in place. This is done by dimpling alternate vanes. The die contains eighteen pairs of stationary die fingers (N) and pivoting punch fingers (M).

the necessary rivet holes for locking the assembly together.

Alongside the drilling position is a probing station that determines whether all eight holes are completely through the parts. Immediately after this check is another station, similar to the first, having an Ex-Cell-O drive unit and a U. S. multiple-spindle drill head, Fig. 6. At this station, all eight holes are slightly chamfered on both ends in one step by using Cogsdill deburring tools. After a pilot on the tool enters the drilled hole a formed cutting lip removes all burrs from the entrance. It then pivots against spring pressure and retracts into the tool body. After clearing the bottom of the hole, the cutting lip is pushed outward once again and, on the up stroke of the drill head, goes through the same cycle to eliminate burrs in this area. Metal particles from the drilling and deburring operations are removed by a vacuum setup at the following station.

Vacuuming of the torus assembly marks the end of the first side of the hairpin-shaped transfer machine. The parts are passed from one side of the line to the other by the swinging-arm type transfer mechanism shown in Fig. 7. In leaving the last station on the first side of the machine, the pallet moves off the main stationary rail and onto a short rail carried at the end of the arm. The arm then elevates the pallet a short distance and, by means of a rack-and-pinion drive *H*, swings through an arc of 180 degrees. It then lowers the pallet in line with the main stationary rail on the return side of the machine.

To avoid problems in an automatic operation such as this it is important that all loose pieces be properly aligned. A check is made at the first station following the swinging transfer arm. Here, floating tapered pins are lowered into each of the eight holes.

The next step is to load rivets into the holes. Because the holes are on such a small circle, two stations are required, Fig. 8, each supplying four rivets to alternate holes. All the rivets are supplied from one box located above the two stations. It continuously pivots back and forth to keep eight chutes *J* loaded with correctly

oriented rivets at all times. Small air jets above each chute keep the rivets moving freely until they drop into eight closed tubes *K*, four leading to each of the two heads. (Only eight tubes are used, although more than that number can be seen.)

At the heads the rivets drop from the tubes and come to rest between pairs of fingers. They are thus held above the holes in the assembly until plungers are lowered to drive them home. It should be mentioned that two spring-loaded pads retain the various members of the torus assembly in place during this step. Another transfer movement brings the pallet to the next station where probing fingers descend to be sure that all the rivets have been inserted.

Heading of the rivets follows. This station is similar to a hydraulic press, except that two rams and two actuating cylinders are used—one above and one below the work. The upper ram carries an anvil that is the first to contact the work, applying clamping pressure to the loose pieces as well as backing up the rivet heads. On the lower ram are eight punches that pass up through holes in the pallet and apply pressure to the rivets to form the heads.

It will be recalled that two tabs on each vane are still protruding from the slots around the torus shell. These tabs are clinched flush against the shell at the following station. With the assembly still riding on the pallet, a head comes down into contact with it and causes it to spin. A side roll and a bottom roll then feed up against the two rows of tabs, spin-crimping them to lock the vanes in place.

One more locking operation is needed. This is done at the following point on the line, Fig. 9, where the torus vane ring is secured to the individual vanes.

While the assembly *L* remains stationary on the pallet, a dimpling die is lowered by a hydraulic cylinder. The die contains paired groupings of eighteen punch fingers *M* and eighteen die fingers *N* that, when the die has been seated in the torus, engage every second one of the thirty-six vanes. After the die-head has bottomed, over-travel of the ram results in a cam action that causes a plate to rotate within the head. Linked to this plate are the punch fingers which are then forced to pivot toward the stationary die fingers, thereby forming dimples in the alternate vanes. These dimples securely button the vane ring into the assembly.

Surge bends are required on the outer ends of

Fig. 10. Surge bends are being made on the outer ends of the vanes. Stationary punch fingers (O), with angular contact faces, force the metal over the desired amount. The vanes are not backed up during bending.

the vanes. This operation is shown being performed in Fig. 10. Here, again, the torus assembly does not move as a die-head is fed downward into it. Thirty-six stationary, high-speed-steel punches *O*, having sloping contact faces, form the necessary bend in the vanes with a cam-like wiping action. The punches do not move within the die-head, nor are they backed up.

Before leaving the transfer machine, the torus assemblies pass through an automatic gaging station. While the assemblies are rotated, shoes are brought into contact with the important faces. Checks are made for plane runout of the shell face, concentricity of the shell periphery, and the height position of all assembled parts for clearance purposes.

Upon leaving the gaging station the workpieces are picked up by a swinging transfer arm (identical to the one at the opposite end of the machine) and deposited at an unloading station. A fork lifts the assemblies from the pallets, whereupon they slide down a chute and onto a conveyor belt that carries them through a Centri-Spray washing unit.

Balancing is an Important Phase of Torus Production

Balancing is of vital importance to the proper functioning of the torus within the Hydra-Matic assembly. To accomplish this quickly and efficiently, a bank of two automatic balancing machines is employed. One of these installations is shown in Fig. 11.

Torus assemblies arrive in the balancing area on hooks suspended from overhead conveyors. When the hooks reach an unloading area they are pivoted, allowing the parts to move down a chute to a loading position in front of one of the balancing machines. An air cylinder then advances the part onto arms that flip it over and automatically load it into the first station (Note blur in foreground).

The part is transferred to an unbalance computation station *P* where it is spun to determine the amount and location of any unbalance. After a few seconds the spinning stops and the torus rotates slowly until the light area, or the spot requiring the addition of a balance weight, is to the outside of the machine (to the right in the illustration). Information regarding the size of the weight is fed by a memory circuit to the next, or correction, station *Q*.

A coil of 1/2- by 1/8-inch strip steel is located near the correction area. Based on information furnished by the preceding station, an appropriate length of steel strip is fed into a small die set where it is cut off and formed to match the inner contour of the torus shell. It is then passed to magnetic pickup fingers that also serve as a resistance-welding electrode. The fingers swing up and clamp the weight against the inside of the shell, while an air cylinder drives a straight electrode *R* into contact with the outer surface of the shell, in line with the balance weight, and a spot weld is made.

To be certain that proper weight has been added, the part is transferred to the next, or balance recheck, station *S*. Again the part is spun, and the corrected balance is checked to within 0.25 inch-ounce. In-tolerance or out-of-tolerance information is relayed to the unloading station of the machine. The torus is moved onto a short chain conveyor which, if the part has been properly balanced, raises and discharges into the upper of two chutes. If not properly balanced, the torus is ejected into a lower chute and subsequently undergoes corrective hand balancing.

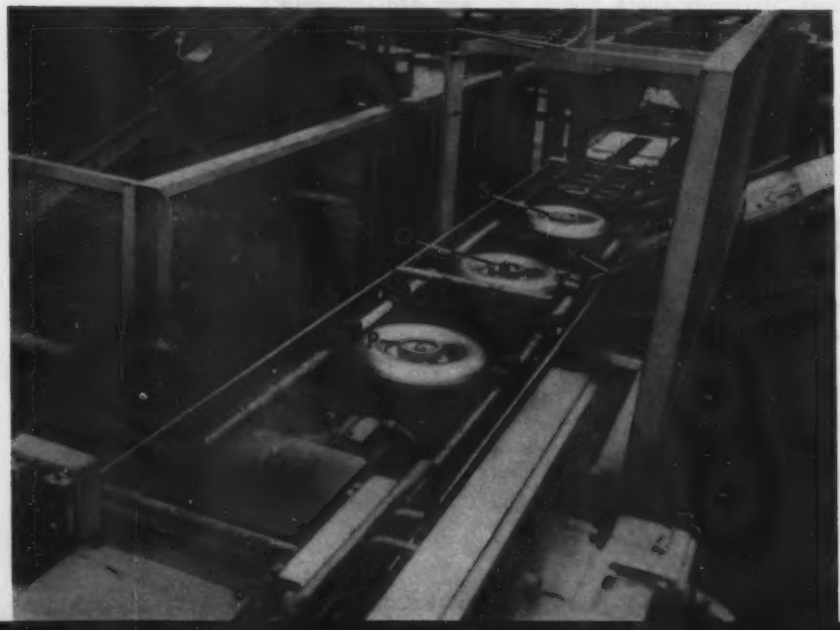

Fig. 11. To function properly, all torus units must be properly balanced before final assembly. Shown here is one of two automatic balancing installations located just after the main transfer line.

Calculations for Deep Drawing of Flanged Shells

In order to compute the blank diameter and the number of operations for deep drawing a flanged shell, an understanding of what actually occurs to the metal is important. The author illustrates how the necessary calculations may be made

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DEEP DRAWING of cylindrical shells from sheet metal is a common press operation and there is little difficulty in computing the proper diameter for the blank. Reduction in blank diameter is limited to a certain percentage by the plastic flow of the metal. If the reduction required is greater, the part must be redrawn after the first operation. Often a series of redraws is necessary to reduce the diameter and increase the height of the work-piece to the desired dimensions.

Sometimes, however, the full length of the shell cannot be drawn into the die. Examples of such parts are shells requiring a flat flange at the open end or a cylindrical projection of smaller diameter extending from the bottom. In the latter case, the projection has to be drawn before the outer shell and, therefore, can be considered as one having a very broad flange. When computing blank diameters and the number of drawing operations for flanged shells, it is important to consider this partial drawing of the blank.

The per cent reduction of the blank diameter depends on the drawing ratio. When drawing a shell without a flange, the drawing ratio m for the first operation is equal to the diameter d_1 of the shell after the first operation divided by the blank diameter D or $m = \frac{d_1}{D}$. Similarly, for the second operation or first redraw: $m_1 = \frac{d_2}{d_1}$ where: $m =$ the drawing ratio for the first redraw and $d_2 =$ the shell diameter after the first redraw.

Thus $m \times D = d_1$, $m_1 \times d_1 = d_2$, etc. The reciprocals B, B_1, B_2 . . . of the various drawing ratios m, m_1, m_2 . . . are convenient for computing the blank diameter from a given shell diameter, since $B \times d_1 = D$, $B \times d_2 = d_1$, etc.

The per cent blank reduction and the drawing ratio must not exceed certain limits. These limits depend essentially on the metal being drawn, on whether blank-holders and hold-downs are used, or if a first operation or a redraw is involved. Values for the drawing ratio are in the range between 0.5 and 0.9 and are compiled in handbooks.

With the drawing ratio known, it is easy to compute the safe maximum height (h) for a drawn shell. This computation is based on the theory that the thickness of the metal remains unchanged after drawing and that the area of the blank is equal to that of the shell. In most cases, the difference between the outer and inner diameter may be neglected because the stock thickness is small compared to the shell diameter. Most shells have to be trimmed at the open end, necessitating a trimming allowance. Although the height will be reduced by this allowance, the additional metal has to be considered when computing both the blank diameter and the height of draw.

If the area of the blank equals the area of the shell (Fig. 1) then

$$D^2 \times \frac{\pi}{4} = \left(d_1^2 \times \frac{\pi}{4}\right) + (d_1 \times \pi \times h_1).$$

Since $B \times d_1 = D$:

$$(B \times d_1)^2 \times \frac{\pi}{4} = \left(d_1^2 \times \frac{\pi}{4}\right) + (d_1 \times \pi \times h_1);$$

after dividing the equation by $\pi\, d_1$

$$B^2 \times \frac{d_1}{4} = \frac{d_1}{4} + h_1.$$

Then by collecting terms and simplifying

$$h_1 = \frac{d_1}{4}(B^2 - 1). \qquad (1)$$

In Equation (1), h_1 represents the safe maximum height for drawing a cylindrical shell of diameter d_1, based on a given drawing ratio m (or its reciprocal B). If a shell of diameter d_1 and height h_1 has to be redrawn to a smaller diameter d_2 (Fig. 2), the height h_2 may be calculated as follows:

$$\left(d_1^2 \times \frac{\pi}{4}\right) + (d_1 \times \pi \times h_1) = \left(d_2^2 \times \frac{\pi}{4}\right) + (d_2 \times \pi \times h_2).$$

Substituting $(m \times d_1)$ for d_2,

$$\left(d_1^2 \times \frac{\pi}{4}\right) + (d_1 \times \pi \times h_1) = \left[(m \times d_1) \times \frac{\pi}{4}\right] + (m_1 \times d_1 \times \pi \times h_2);$$

dividing the equation by $\pi\, d_1$

$$\frac{d_1}{4} + h_1 = \frac{m^2 \times d_1}{4} + (m \times h_2),$$

or
$$h_2 = \frac{d_1\,(1 - m^2)}{4\,m} + 4\,h_1. \qquad (2)$$

If the bottom of a shell has to be provided with a smaller cylindrical projection, its safe maximum depth also depends on its diameter and the drawing ratio. Should the proposed depth exceed the safe maximum height of a similar shell, the projection has to be redrawn. As shown in Fig. 3, the surface area of the wall after the first operation remains equal to that after redrawing and the depth of the projection is increased in the same ratio as its diameter is reduced.

Thus,
$$d_1 \times \pi \times h_1 = d_2 \times \pi \times h_2$$

and
$$d_1 \times h_1 = d_2 \times h_2. \qquad (3)$$

In this case, there is no further reduction of the flange diameter by the redraw because the shell is not drawn full length into the die. That portion of the bottom between the two diameters is redrawn back into the flange. Therefore, the height h_2 is limited and cannot equal that corresponding to the drawing ratio possible if the part did not have a flange.

In practice, the die designer has to start with the dimensions of the finished part. It is therefore advisable to use the reciprocal value B in determining the blank diameter. Whenever a flanged part is drawn, only a portion of the blank is transformed into the shell and the reduction in blank diameter does not correspond to the true reduction undergone by the material. The blank D (Fig. 4) is reduced to the flange diameter D_1 and the material in the ring $D - D_1$ is equal to the material used for building up the wall of the projection. Therefore, if D' equals the theoretical blank diameter for drawing an unflanged cylindrical shell having a diameter d_1, then

$$\left[(D')^2 \times \frac{\pi}{4}\right] - \left(d_1^2 \times \frac{\pi}{4}\right) = \left(D^2 \times \frac{\pi}{4}\right) - \left(D_1^2 \times \frac{\pi}{4}\right)$$

and since $D' = d_1 \times B$

$$\left[(d_1 \times B)^2 \times \frac{\pi}{4}\right] - \left(d_1^2 \times \frac{\pi}{4}\right) = \left(D^2 \times \frac{\pi}{4}\right) - \left(D_1^2 \times \frac{\pi}{4}\right);$$

dividing the equation by $\frac{\pi}{4} \times d_1$

$$d_1\,(B^2 - 1) = D^2 - D_1^2$$

or
$$D = \sqrt{D_1^2 + d_1^2\,(B^2 - 1)} \qquad (4)$$

and
$$D_1 = \sqrt{D^2 - d_1^2\,(B^2 - 1)}. \qquad (5)$$

Equations (4) and (5) are useful for computing either the necessary blank diameter for a proposed flange diameter or the flange diameter from a given blank diameter when the drawing diameter d_1 and ratio m are known. If the work-piece requires trimming after drawing, the trimming allowance again has to be considered. Example: A blank has to be drawn into a flanged shell having a diameter of 2 inches, a height of 1.8 inches, and a flange diameter of 6 inches. The material permits a drawing ratio of 0.6 for the first operation, which means that the safe maximum reduction is 40 per cent. How many drawing operations are necessary? What are their diameters, and what should be the diameter of the blank?

Since $d_1 = 2$ inches and $B = \frac{1}{0.6} = 1.67$, the safe maximum height of draw can be determined by Equation (1):

$$h_1 = \frac{d_1}{4}\,(B^2 - 1)$$

$$= \frac{2}{4}\,[(1.67)^2 - 1]$$

$$= 0.9 \text{ inch.}$$

The result shows that it is impossible to obtain the proposed height of 1.8 inches in one operation. Redrawing is necessary and, therefore, the diameter of the proposed shell will be d_2 or d_3 depending on the number of redraws required. Let the drawing ratio (m_1) for the first redraw be 0.8. Thus, $B_1 = \frac{1}{m_1} = 1.25$ and the drawing diameter for the preceding operation, $d_1 = d_2 \times B_1 = 2 \times 1.25 = 2.5$ inches.

Since the wall area of a flanged shell must remain the same for the first operation and the re-

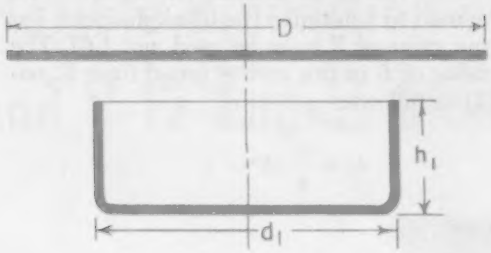


Fig. 1. When a blank is completely drawn in a die, the surface area and thickness of the resulting shell may be considered equal to those of the blank.

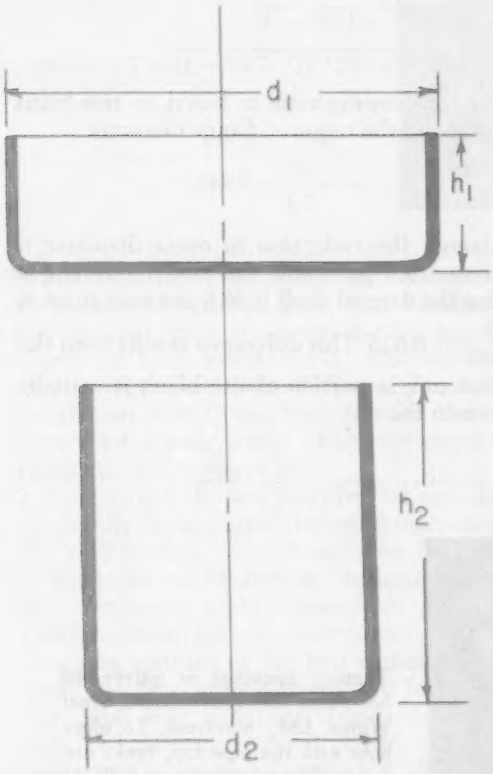


Fig. 2. Redrawing is necessary if a part cannot be produced in a single operation without exceeding the safe limits on blank reduction or shell height.

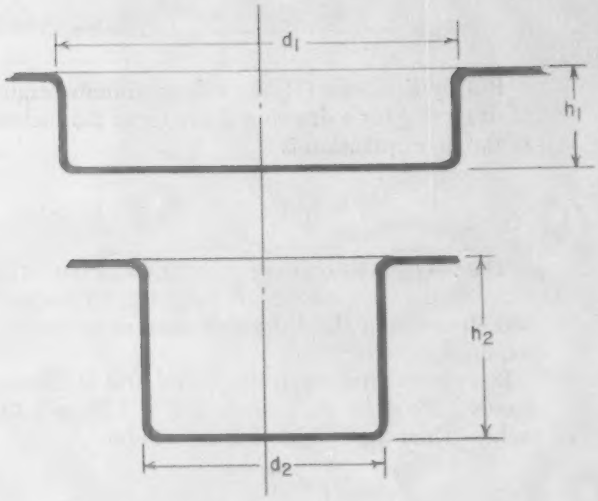


Fig. 3. Flanged shells are not drawn full length into the die. If redrawing is necessary, a portion of the shell is redrawn back into the flange.

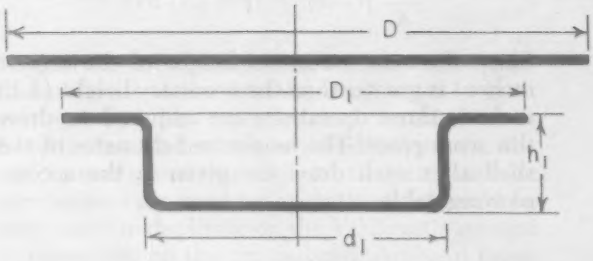


Fig. 4. In producing a flanged part, only a portion of the blank is drawn into the shell. The true reduction of the drawn metal is greater than that indicated by the change in the diameter of the blank.

CALCULATED DRAWING DIMENSIONS
for the Flanged Shell in the Accompanying Example

	Diameter of Shell Inches	Height of Shell Inches
First draw	3.13	1.15
First redraw	2.5	1.44
Second redraw	2.0	1.8

draw, the necessary height of draw (h_1) for the first operation is found by Equation (3):

$$h_1 = \frac{d_2 \times h_2}{d_1} = \frac{2 \times 1.8}{2.5} = 1.44 \text{ inches.}$$

But by Equation (1), the safe maximum height of draw (h_1) for a drawing diameter of 2.5 inches in the first operation is

$$h_1 = \frac{d_1}{4}(B^2 - 1) = \frac{2.5}{4}[(1.67)^2 - 1] = 1.13 \text{ inches.}$$

The necessary height of draw (1.44 inches) still exceeds the safe maximum height (1.13 inches) and therefore a third draw or second redraw is required.

If a second redraw is employed and B_1 again equals 1.25, $d_1 = d_2 \times B_1 = 2.5 \times 1.25 = 3.13$ inches. Then the height of draw will be

$$h_1 = \frac{d_2 \times h_2}{d_1}$$

$$= \frac{2.5 \times 1.44}{3.13}$$

$$= 1.15 \text{ inches.}$$

From Equation (1), the safe maximum height of draw for a drawing diameter of 3.13 inches is

$$\frac{3.13}{4}[(1.67)^2 - 1] = 1.41 \text{ inches.}$$

Since the safe maximum height of draw (1.41 inches) is greater than the necessary height (1.15 inches), three operations are required to draw this work-piece. The height and diameter of the shell after each draw are given in the accompanying table.

In computing the blank diameter, the fact that the shell height after the first draw is less than 1.41 inches has to be considered. Equation (4) can be used to determine the blank diameter but the true value of B must be used, not 1.67. The true value of B in this case is found from Equation (1) as follows:

$$h_1 = \frac{d_1}{4}(B^2 - 1)$$

therefore

$$B = \sqrt{\frac{4h_1}{d_1} + 1}$$

$$= \sqrt{\frac{4 \times 1.15}{3.13} + 1}$$

$$= 1.575$$

Substituting this value for B in Equation (4), blank diameter D is easily calculated.

$$D = \sqrt{D_1^2 + d_1^2(B^2 - 1)}$$

$$= \sqrt{(6)^2 + (3.3)^2[(1.575)^2 - 1]} = 7.1 \text{ inches.}$$

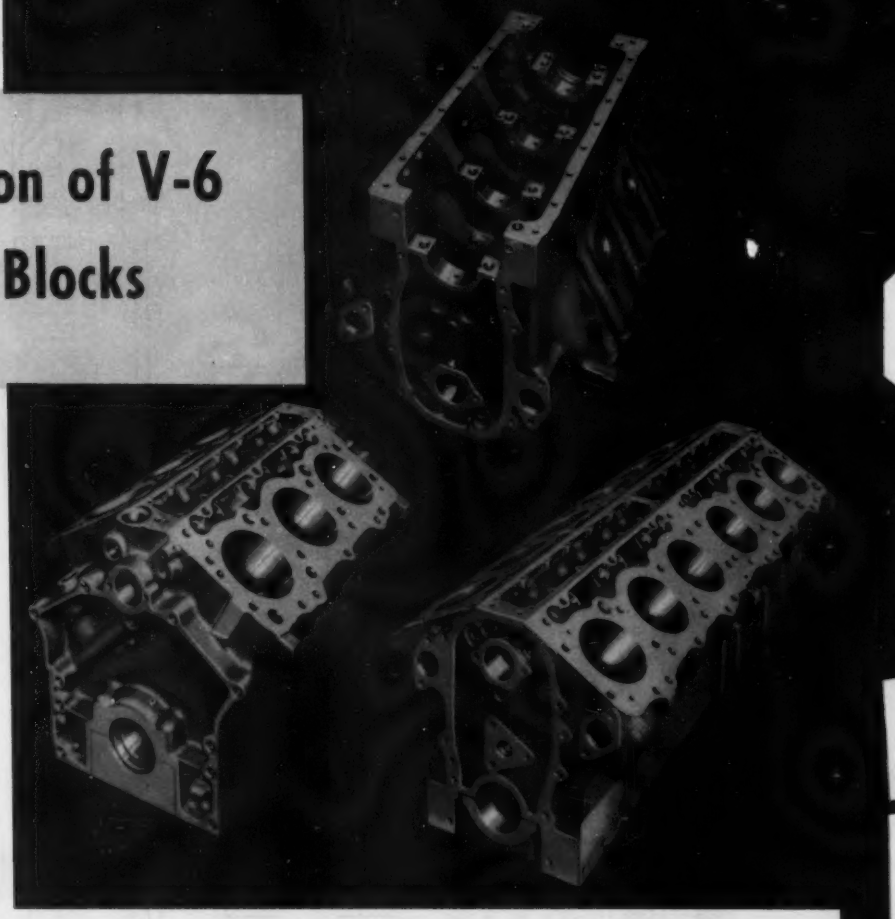
Solving for drawing ratio m based on this blank diameter and the required flange diameter

$$m = \frac{6}{7.1} = 0.845.$$

Although the reduction in outer diameter is thus only 15.5 per cent, the true reduction in drawing the flanged shell is 36.5 per cent since $m = \frac{1}{1.575} = 0.635$. This difference results from the fact that only a portion of the blank is actually drawn into the die.

Tapping openings in galvanized hot-water tanks, at General Steel Wares, Ltd., Montreal. To align hole with the pipe tap, tanks are fed to the tool-spindle on a floating trolley. Lubricant brushed on is 'dag' 242, a dispersion of mica in oil made by Acheson Colloids Co., Port Huron, Mich.

Flexible Production of V-6 and V-12 Engine Blocks



New techniques have been applied in the handling of engine blocks so that castings for two different-sized engines can be machined on the same transfer line

A PRODUCTION breakthrough has been made by a major midwestern truck manufacturer who, for the first time, is automatically machining blocks for both V-6 and V-12 gasoline engines on the same "sectionized" Transfer-matic. The installation, which was built by The Cross Co., does a job which would otherwise require two complete and separate lines.

Similarity of the two parts helped considerably to simplify the design of the equipment—in effect, the V-12 block is two V-6 units cast in one piece. Both blocks can be seen in the heading illustration (opposite ends exposed to view): six-cylinder, lower left; twelve-cylinder, lower right. Common features of the two cast-iron parts include identical cross sections and hole patterns, front and rear; identical cylinder-head mountings; and so forth. A total of 579 metal-cutting operations is performed on the V-6 block, and 901 on the V-12. Of these totals, 454 operations are common to both, 125 are performed only on the V-6, and 447 only on the V-12.

The 450-foot-long line contains six sections (Fig. 1) each of which can be changed over from the production of one block to the other with an average of four man-hours work. Such a changeover would normally require about two weeks per section. Each basic machine section is designed to handle all of the operations common to both castings. Stand-by spindles and machine units have been added where required to perform the uncommon operations. Special two-step transfer mechanisms are used for operations that must be performed in duplicate on the V-12 castings—that is, operations on the top and cylinder-head faces.

Blocks enter Section I of the Transfer-matic (Fig. 2, lower left) after some preliminary broaching, boring, and milling operations have been completed. A shuttle mechanism in the line picks up the block (pan face up, front end leading), indexes it through an arc of 90 degrees (front end to the right), and positions it over the machine's lift-and-carry transfer mechanism. At the first station a turnover mechanism rotates the block through 180 degrees, bringing its pan face down (front end still to the right). As it travels through the machine, sixteen power heads in the section's thirty stations perform drilling, reaming, chamfering, and tapping operations on both ends of the block. These include rough and semifinish boring of camshaft holes, drilling of oil-gallery holes, and boring of the distributor hole from the top of the machine. The oil-gallery holes, incidentally, are drilled progressively as the block

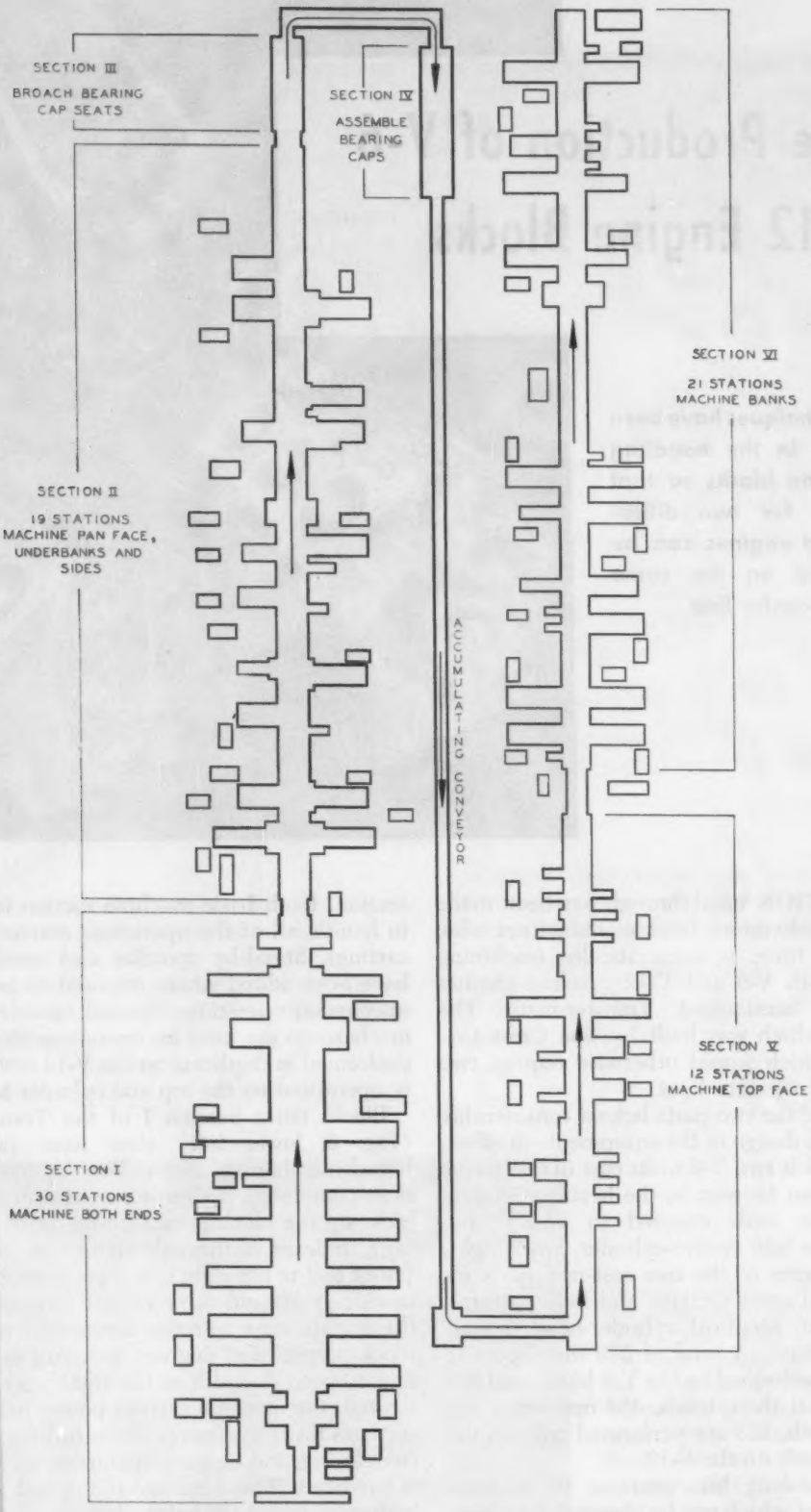


Fig. 1. Layout of 450-foot-long transfer machine showing all six sections and providing an operational breakdown within each. This line will handle blocks for both six- and twelve-cylinder gasoline engines with a minimum of change-over time.

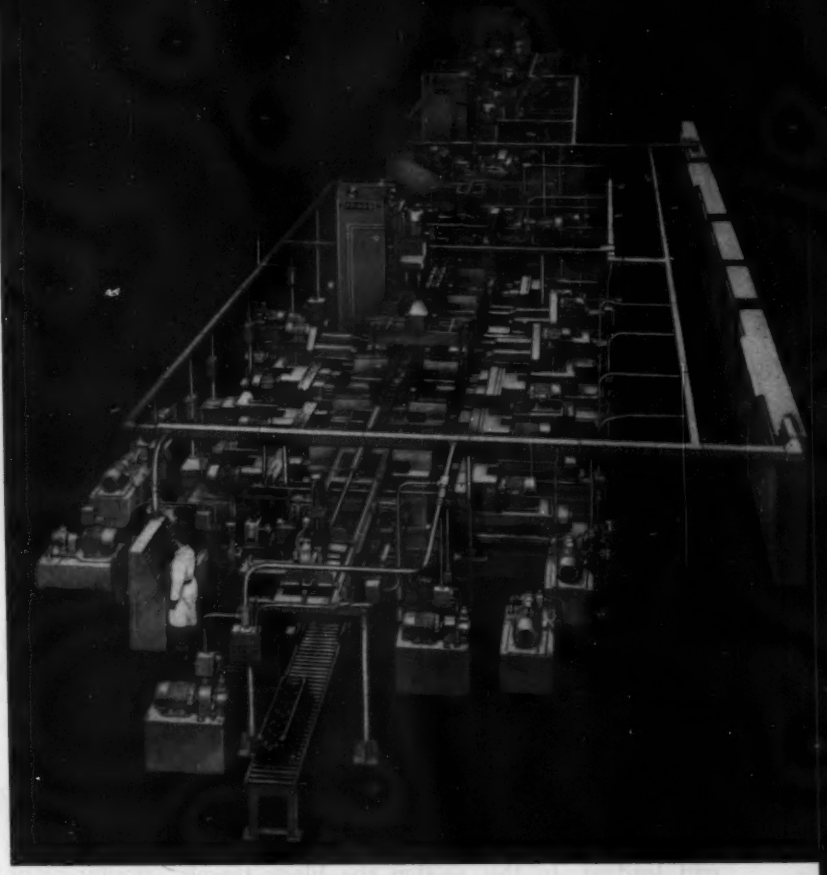


Fig. 2. First leg of the Transfer-matic. Either V-6 or V-12 blocks enter Section I (bottom) for end machining, then pass on to Section II (top) for pan-face and side machining. The block shown on the entrance conveyor is rotated 90 degrees before reaching the first machining station.

advances from station to station. They are exceptionally deep holes, requiring from five to eight passes for completion.

All operations performed in Section I are common to both the six- and twelve-cylinder engine blocks, except for additional camshaft boring operations required by the larger model. A change-over to the six-cylinder block in this section would involve locking the V-12 spindles in stand-by position by means of a selector switch, manually adjusting the fixtures and material-handling equipment, and changing the tools.

Provisions for a banking station, typical of several similar stations along the line, have been made at the end of this section, Fig. 3. At these banking stations it is possible to manually remove the blocks from the line. This permits block change-over in one section, without halting production in the others.

On leaving Section I the block is again rolled through an arc of 180 degrees (pan face up), then turned 90 degrees (front end leading). In this position, Fig. 3, it enters Section II where all holes in the pan face—including bearing caps, pan rail, oil drain-back, oil filter, and oil holes for bearings—are machined. Holes other than the ones located in the pan-face area, such as those for welsh plugs and oil-filter mounting, are also accounted for. In all, twenty-six heads are brought into action as the block travels through the nineteen stations comprising Section II.

Of interest is the way tool changing has been expedited at Station 12, Fig. 4. Spindles at this location feed straight down to tap holes in the pan face. To facilitate tap replacement, a hydraulic cylinder behind the drive-head tilts it back as shown.

Holes in the V-12 pan face are arranged in two identical groups, each group common with that on a single V-6. However, they are displaced 3.2 inches from the other holes that are common to both parts. A novel shuttling arrangement has been combined with the transfer mechanism to take care of this offset, thus making the heads usable for both parts. After the V-12 cylinder block is transferred into Station 14, Fig. 5 (normal work flow is from right to left), it is lifted from the transfer nests by a floating carrier A. As the transfer bar returns, a dog on the bar moves the block and the carrier 3.2 inches to the right, Fig. 6. The carrier then lowers the block onto the transfer bar, ready for advancement into the next work station. When the blocks are transferred forward (to the left), a second dog on the transfer bar resets the carrier 3.2 inches to the left to receive the next casting. This shuttle movement is not used for the V-6 block.

There are 104 operations, common to both blocks, performed in Section II; this is in addition to 180 boring, drilling, chamfering, and tapping operations required by the larger cylinder block only. As in the first section of the Transfermatic, change-over here involves the use of a selector switch to automatically lock out machining heads not required; manual adjustments to conveyors, fixtures, etc.; and tool changing.

The block is then transferred automatically to Section III of the line, a broaching operation. Here the bearing-cap seats are finish-broached, after which the work is moved to Section IV where the bearing caps are assembled. Following this, the blocks are automatically loaded on a 100-foot-long accumulating conveyor (Fig. 1). This conveyor, located at about the center of the flattened S-shaped line, plays an important role in maintaining steady production during change-

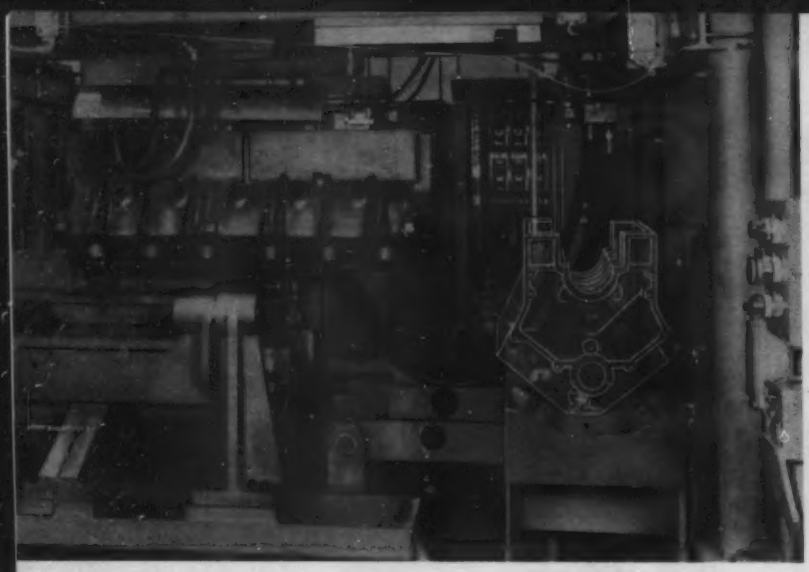


Fig. 3. (Left) Automatic handling unit between Sections I and II. Blocks enter this station from the right (shown by phantom part), are lifted and indexed through 90 degrees, then carried to the next machine section at the left. At the turn-around station, the castings can be removed from the line for banking.

Fig. 5. (Right) To accommodate a displacement in hole patterns between the two sizes of blocks, the V-12 casting is shifted slightly at this station to bring it in line with the multiple heads used on the V-6. Normal flow of blocks is from right to left.

Fig. 6. (Far Right) Floating carrier (A) lifts the block from the main transfer bar, moves it to the right a distance of 3.2 inches—from the position shown in Fig. 5 to that shown here—then replaces it on the transfer bar. Arrows in both illustrations indicate dogs that drive the carrier back and forth.

over by supplying Sections V and VI with a sufficient number of semiprocessed castings.

Section V—foreground, Fig. 7—which machines the top face of the blocks, is located at the opposite end of the accumulating conveyor. A lift-and-carry conveyor takes the blocks from the accumulating line and deposits them on an extension of the section's main transfer mechanism. The parts are then advanced pan rail down, front end leading. In this section the block travels through twelve stations where eighteen machining heads perform drilling, chamfering, reaming, and tapping in connection with the dip-stick and breather holes, a hole on each side of the banks, and a pattern of holes on the top face.

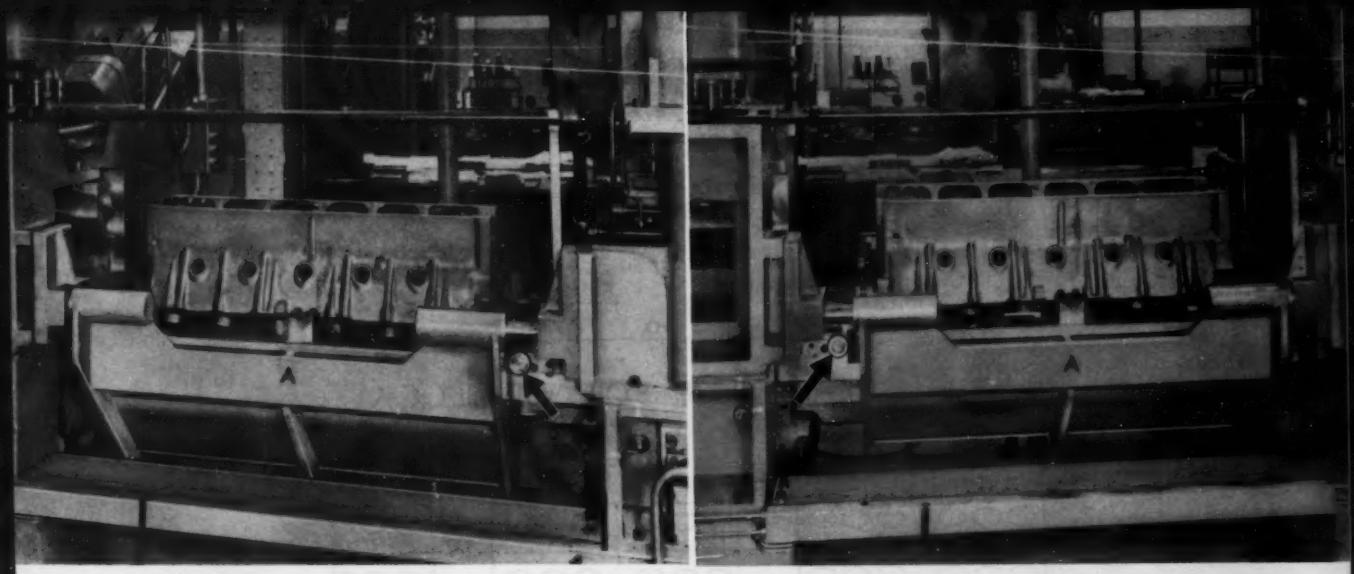
Most of the operations performed in Section V are common to both sizes of blocks, except that there are approximately twice as many holes to be machined on the larger. These additional holes in the V-12 engine are arranged in a pattern identical not only to that of the V-6 engine, but also to that of the first V-12 group. To accommodate machining of the extra holes, an arrangement for double cycling of the V-12 block—sending it through the same head twice—has been worked out. Although this method increases the machining time, it cuts the spindle requirement in half.

Double cycling is accomplished with a novel transfer mechanism that provides the movements shown in Fig. 8. When V-6 blocks are run (top) they are transferred through a distance of 54 inches, directly from station to station. In the case of V-12 blocks, however, this distance is traveled in two movements (bottom): the first, 20 1/4 inches; the second, 33 3/4 inches. In this way, all heads function twice for each casting.

Final operations are performed at Section VI (background, Fig. 7) where the banks of the blocks are machined. Castings are automatically transferred here from Section V in the same position (pan rail down, front end leading) by a lift-and-carry mechanism. The blocks travel through twenty-one stations in which twenty-eight machining heads complete all drilling, reaming, chamfering, boring, and tapping of the bank faces. As before, double-cycling compensates for the additional holes in the V-12 units.

Another variation between the two blocks

Fig. 4. In Station 12 of the second section the pan face of the block is machined. Tool change at this station is facilitated in an interesting way. The drive-head is normally in a vertical position but, to provide access to the spindles, it is tilted as shown by a hydraulic cylinder.



which must be compensated for at Section VI is a difference in the offset of the hole patterns between the right- and left-hand banks of cylinders. This is taken care of by special shuttle arrangements which shift the positions of specific drill heads and bushing plates.

In production, the line can completely machine a V-6 block (of three different versions) every fifty-four seconds, or a V-12 type in less than two minutes. When operating at 100 per cent efficiency, the rated output of the line is sixty-seven V-6, or thirty-five V-12 blocks per hour. A number of innovations incorporated in this automatic line have an important bearing on its performance. Nine probe and auxiliary unload stations, plus an air test station, are built into the line at strategic points. They automatically perform 171 inspection operations on the V-6 block, and 231 on the V-12, checking hole sizes and preventing defective blocks, or those with broken tools, from traveling to a subsequent station.

Idle stations—twenty-five of them are provided along the line—allow for the emergency unloading of blocks and permit heat generated in machining to dissipate before it affects the work or fixturing. Also, in line with the building-block

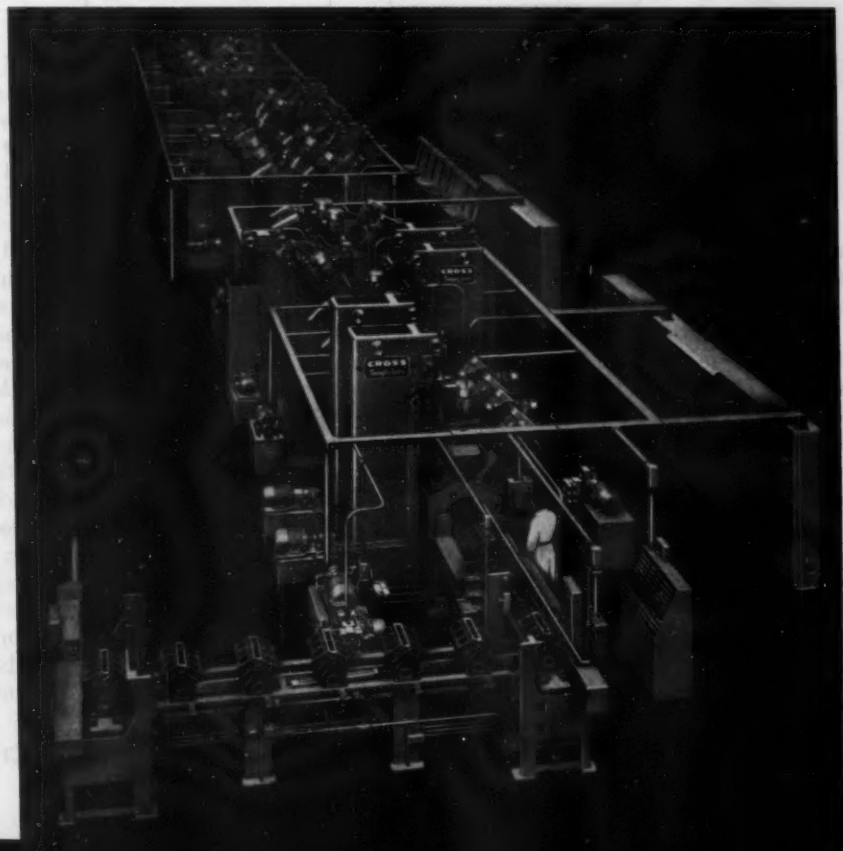


Fig. 7. Final leg of the transfer line. The top face of the block is machined in Section V (bottom) which consists of twelve stations having a total of eighteen heads. In Section VI (top) the banks of the blocks are finished at twenty-one stations having a total of twenty-eight heads.

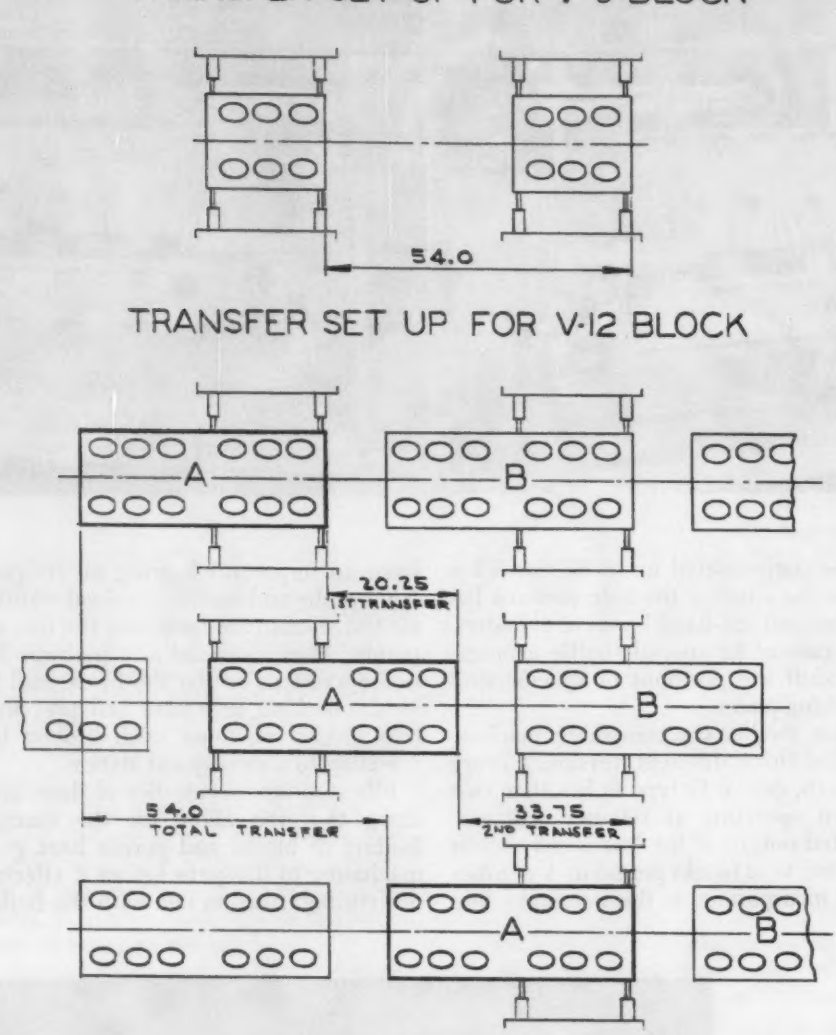


Fig. 8. Multiple heads in the last two sections that have been designed for the V-6 must be cycled twice to complete the V-12. The smaller blocks are transferred 54 inches, directly from station to station (top). V-12 blocks cover the same distance in two movements (bottom); the first being 20 1/4 inches and the second 33 3/4 inches. The heads are cycled after each movement.

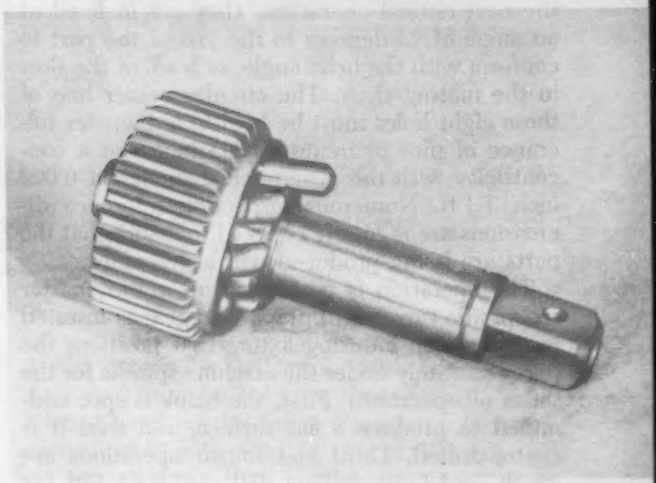
concept for automatic machine tools, such idle stations provide space for incorporating additional equipment in the future.

A simple coding system makes spindle setup during change-over from one block to the other virtually foolproof. The spindles are coded with machined-in rings. Two rings mean that the spindle is to be used only on the V-12 block, while one ring indicates use only on the V-6. Spindles having no markings can be used on either block. This coding system is also valuable during routine tool changes as it is carried out to the Machine Control Units, thus assuring correct matching of tools and spindles.

Seventeen of these Machine Control Units are installed at key locations along the line to automatically control all machining operations requiring regular tool changes. This is accomplished by Toolometers—special timing devices located on the main control panel of each unit. When a tool is installed, the timer is manually set to operate for a time equal to the predetermined life of the tool, and its pointer indexes counterclockwise with every cycle of the machine. As the pointer reaches zero, the machine automatically stops so that a new tool can be installed. The storage area of each control unit provides space for two complete changes of pre-set tools.

Both cemented-carbide and high-speed-steel tools are used throughout the line. Carbides are employed for boring at speeds of 200 to 300 fpm (feet per minute), and for reaming at 100 fpm. Drilling and tapping speeds with high-speed steel vary between 40 and 70 fpm.

Fig. 1. Drive-shaft sub-assembly is the core of an automatic tube-expander drive. Torque is transmitted from the central shaft to the outer gear by drive-pins riding in spiral grooves. An axial thrust is thus developed that is proportional to the applied torque.



Helical-Keyed Drive-Shaft is Heart of Torque-Sensing Mechanism

SAMUEL HERMAN, Shop Superintendent
Thomas C. Wilson, Inc., Long Island City, N. Y.

TUBULAR TYPES of boilers and heat exchangers are constructed with groups of tubes arranged in various patterns. These tubes are located between, and pass through, terminals such as steam and water drums, tube sheets, and headers. Such construction permits distribution of heat while separating the hot gases from the water, or miscellaneous liquids from one another.

Tube expanding, or rolling, is a mechanical method of providing uniformly strong and pressure-tight joints between the tube and its seat. Equipment for doing this is manufactured by Wilson and incorporates the company's Torque-Air-Matic tube-expander drive. This is an air-driven, completely integrated drive that accurately controls the expansion of tubes by directly measuring torque output at the expander mandrel. When a predetermined torque has been reached, the expander automatically stops rotating.

Heart of the torque-sensing mechanism is the drive-shaft sub-assembly shown in Fig. 1. Eight helical slots are provided on the left-hand end of the shaft. The output spindle gear of the control mechanism is keyed to the drive-shaft by eight drive-pins that are free to slide in the spiral grooves. Transmission of motion between the spindle gear and the drive-shaft creates a thrust which is proportional to the applied torque. This thrust is measured and made to actuate a pivot valve which controls the air flow to the driving motor.

The spindle gear is produced from 1 3/4-inch-diameter bars of leaded SAE 4150 steel. After the blank is rough-turned on a Warner & Swasey No. 5 turret lathe, it is normalized to relieve all machining stresses and then sand-blasted. Following this, the parts are centered and finish-turned on a Lodge & Shipley lathe to produce diameters and faces that are concentric and square within 0.001 inch T.I.R. (total indicator reading). An extended shank (View A in Fig. 2) is machined to 0.7500 inch, plus or minus 0.0005 inch, and is required primarily for the subsequent gear-cut-

ting operation. It is later removed. A stub gear tooth, having a 20-degree pressure angle, is produced on a Fellows gear shaper using a special cutter to obtain the 20/26 pitch required.

Machining of the drive-pin holes, View B, is the next critical operation. They are inclined at an angle of 23 degrees to the axis of the part to conform with the helix angle, or lead, of the slots in the mating shaft. The circular center line of these eight holes must be held to a diameter tolerance of plus or minus 0.0005 inch and a concentricity with the gear pitch diameter of 0.002 inch T.I.R. Numerous inspection reference dimensions are regularly checked to assure that the parts are being produced within tolerance.

The operation is performed on a Burgmaster six-spindle turret drill press. The gear is inserted in a precision indexing fixture that positions the part accurately under the machine spindle for the series of operations. First, the blank is spot end-milled to produce a flat surface, and then it is center-drilled. Third and fourth operations are rough- and finish-drilling, followed by a fifth, or reaming, operation. The fixture is then indexed through an angle of 45 degrees and the sequence is repeated until all eight drive-pin holes have been completed.

In the remaining operations, the spindle gear is faced, drilled, bored, and the internal forming is completed on a turret lathe, leaving the necessary cleanup allowances for grinding operations to follow. During another turret lathe operation, the shank is parted off and additional turning is performed. The gear is then hardened in neutral salts at a temperature of 1550 degrees F. and oil-quenched. This is followed by tempering at 350 degrees F. for two hours, resulting in a hardness of 52 to 55 Rockwell C. Two critical internal diameters are now finished on a Bryant internal grinder to limits of plus 0.0005 inch minus zero. The completed spindle gear can be seen in View C, Fig. 2.

Drive-shafts (Fig. 3) are produced from SAE 4140 annealed steel. Blanks are centered and turned on both ends in two successive turret lathe operations, after which the drive-square (right-hand end in illustration) is end-milled. The eight spiral slots are first rough-milled with a circular form cutter while the blank is held between centers. They are then finish-milled to obtain a smooth surface finish and to meet concentricity requirements.

A final lathe operation is required to reduce the extreme left-hand diameter to pregrinding size

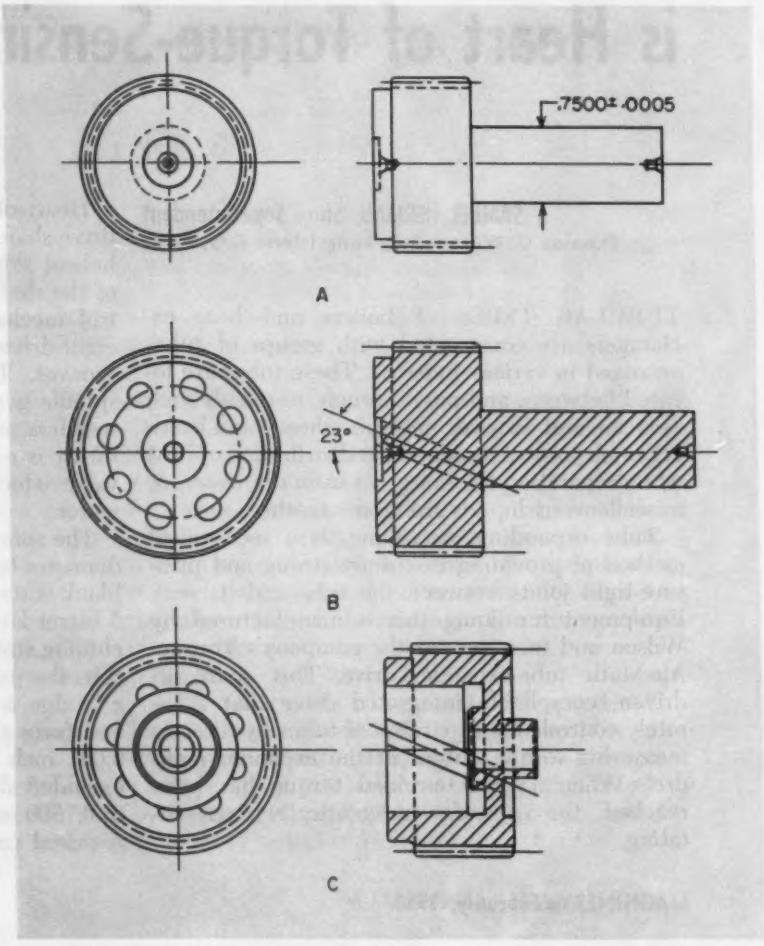


Fig. 2. Three manufacturing stages of the spindle gear shown on the left of the sub-assembly in Fig. 1. At A, the part is rough-machined and the gear teeth are cut; at B, the drive-pin holes are machined; and at C, final machining, heat-treating, and grinding are done.

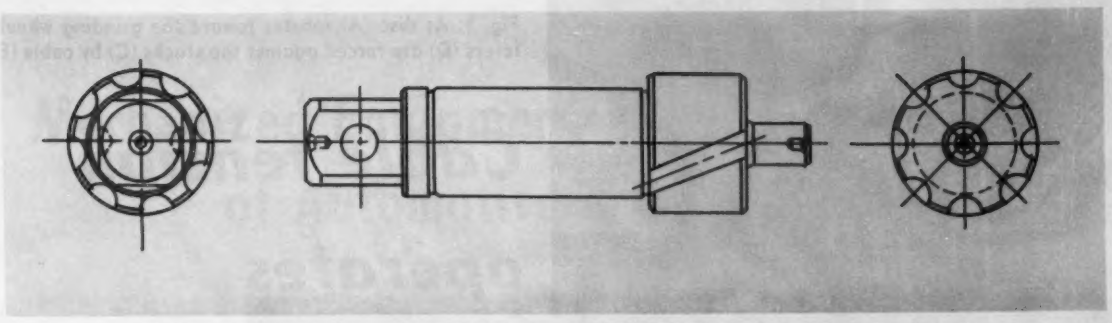


Fig. 3. Drive-shaft is machined from annealed SAE 4140 steel and later hardened to Rockwell C 55 to 57. The drive-square is induction-drawn to a number ranging from 50 to 52. Eight spiral slots are rough- and finish-milled with a form cutter.

before hardening. This end had been left oversize to maintain rigidity and thereby minimize deflection of the part during milling. Also, two drill spots are required on opposing faces of the drive-square prior to heat-treating.

The part is hardened and drawn to a Rockwell C number of 55 to 57. A lower number, ranging from 50 to 52, is required for the drive-square and is obtained by selective drawing on a Thermonic high-frequency induction-heating machine. Following heat-treating, three diameters are finished on a plain cylindrical grinding machine to limits of plus or minus 0.001 inch.

Drive-shafts are now ready to be sub-assembled with the spindle gears for honing of the matched drive-pin holes. The two component parts are held together with a shoulder screw to make the sub-assembly rigid. As can be seen in Fig. 4, a slender mandrel with its expandable honing stone is inserted into one hole at a time. A single stone is being used on this Sunnen machine. It is aluminum oxide with a grain size of 150 grit and has an extremely hard bond to minimize wear.

While the honing tool is rotating, the operator strokes the sub-assembly over it at the proper angle. A tapered rod forces the stone out radially from the end of the tool when a foot pedal is depressed, and the work is checked frequently with a 0.2510 "Go"–0.2520 "Not Go" plug gage. As a result of this honing operation, heat-treating distortion and minute machining errors are compensated for, thereby producing a matched set of parts that are subsequently joined with eight drive-pins.

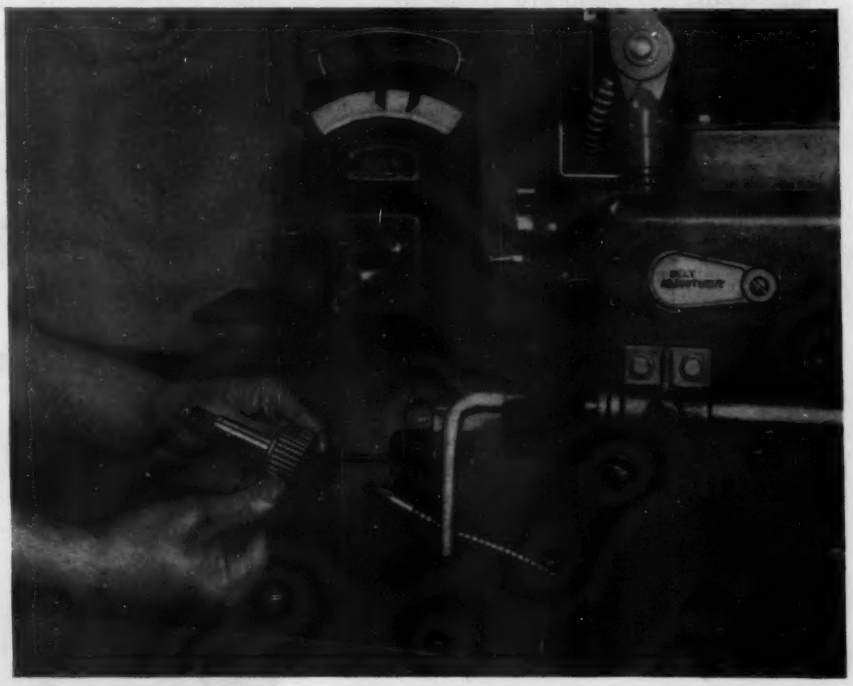


Fig. 4. Honing is the final step in the manufacture of matched pairs of drive-shafts and spindle gears. With the parts locked together and hand-held, one hole at a time is stroked over a single, 150-grit stone on the end of a slender mandrel.

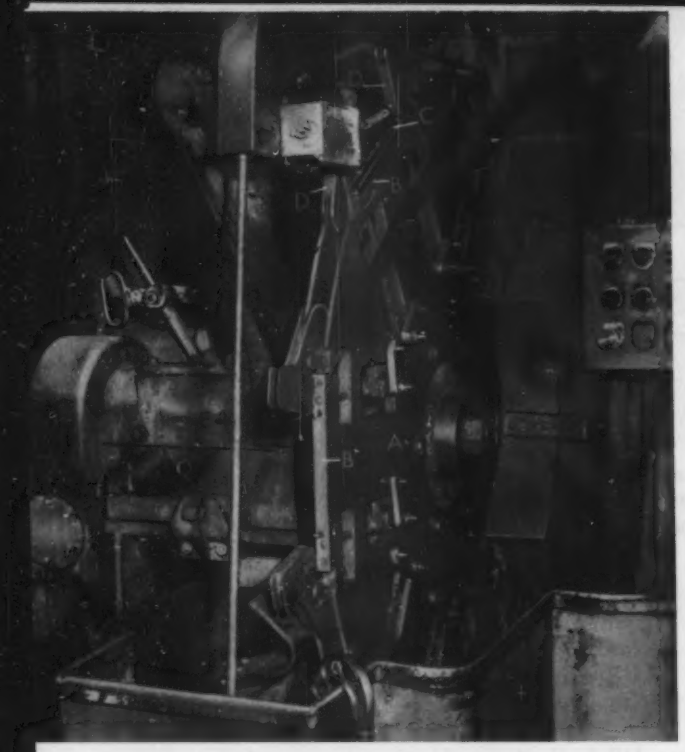


Fig. 1. As disc (A) rotates toward the grinding wheels, levers (D) are forced against the stacks (C) by cable (E).

Cable tension operates work-clamping levers

HERBERT CHASE

TWO INTERESTING grinding setups at the Whirlpool Corporation, St. Joseph, Mich., illustrate how modern manufacturing practices assist this company in maintaining a leading position in the automatic home-laundry equipment field.

The first setup, Fig. 1, involves a Besly double-horizontal-spindle disc grinder. Work-pieces, called cam-bars, are narrow, flat stampings which require parallel grinding of their edges. A feature of the operation is the provision for clamping the work around the periphery of the rotary feed unit.

This unit is a disc *A* which rotates slowly, intersecting the grinding zone of the two wheels. Around the disc are seven fixture bars *B*. Each bar carries a stack of five stampings *C*. To locate the work properly, pins near the ends of the bars engage holes in the stampings.

Clamping is performed automatically by the pivoting of levers *D* positioned over both ends of each bar. The outside of the levers is in the form of a channel which passes under a cable *E* looped around the disc. A counterweight keeps the cable taut. As each stack indexes past the grinding wheels, pressure from the cable tension forces the levers against the stacks, clamping them firmly. After being ground, the stacks reach a point where the levers no longer are under cable pressure. There the stampings drop onto a belt which conveys them away from the machine. Production rate is 1200 cam-bars per hour.

In the second setup, Fig. 2, three diameters of small pinion-shafts are ground simultaneously on a Cincinnati centerless machine equipped with a stepped wheel. This machine functions automatically, it being necessary for the operator only to keep the feed hopper loaded.

After each work-piece is ground, it passes through an air gage on its way to the discharge chute. Sizes of the three gaged diameters appear on dials having marked limits. As it wears, the wheel is adjusted automatically to hold correct size. Output is 200 pinion-shafts per hour.

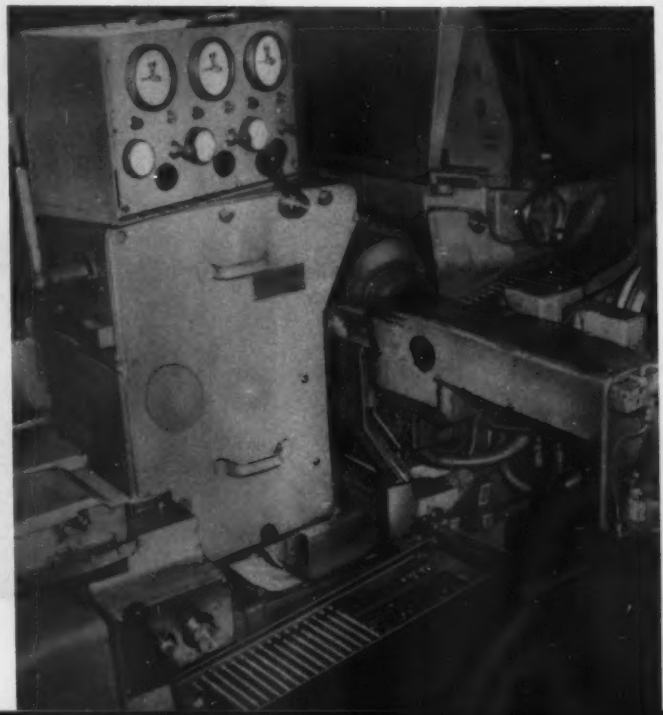


Fig. 2. Three diameters are centerless ground simultaneously, then exit through an air gage. Dial reading unit can be seen on top of machine.

Mechanized Equipment Expedites Handling of Automotive Sheet Metal

HERBERT CHASE

Addition of automatic units has reduced handling costs and increased hourly output. Loading and unloading of presses now require less manual labor, while operator safety has been increased

CONSIDERABLE new equipment has been added in the sheet-metal plant of the Buick Motor Division, General Motors Corporation, Flint, Mich., to handle stampings for their chassis on a highly efficient basis. One objective was to minimize manual work-handling, where possible, through the use of mechanized equipment and, at the same time, to promote safety. Stampings to be considered here are the engine oil-pan and the front fenders, all of which have been changed in design. Several new presses, some of large size, have been installed to replace older units that performed similar operations, but on a less-efficient basis.

Oil-pans for Buick engines have been produced in this plant for many years and have involved deep drawing over most of their area. Alterations in the chassis, however, reduced clearances below the front of the pan, making it necessary to produce one that is shallow at the front but deeply drawn at the rear.

Several presses were used for the old pan and

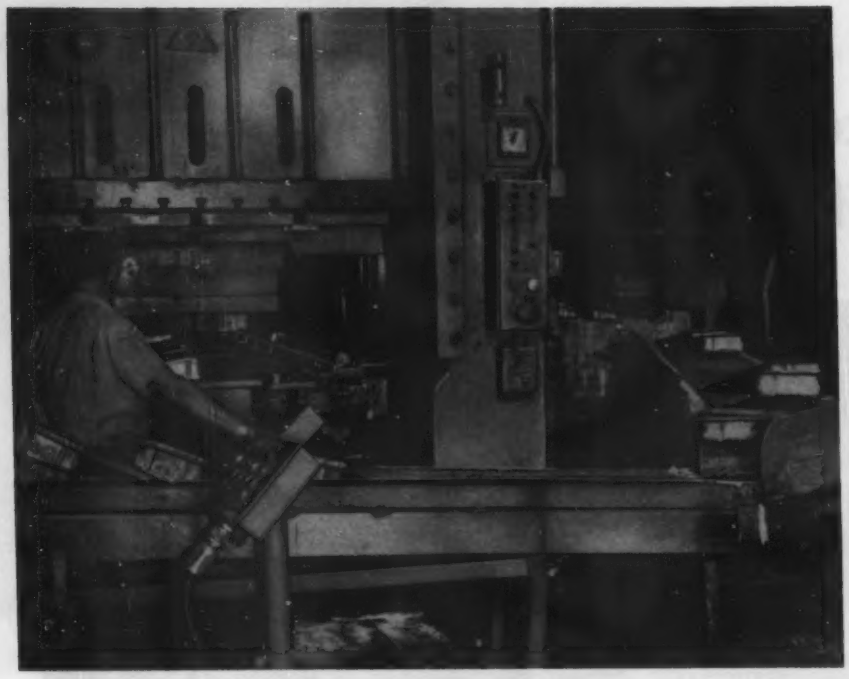


Fig. 1. Partially drawn oil-pans are removed from the first press (right, background) and placed on a belt conveyor. This transports them to the lead unit (left) in a line of four presses.

shifting the work between them was largely manual. With the new presses and new dies, handling is, to a great extent, mechanized. Deep-drawing stock of 0.060-inch thickness is received at an 850-ton Verson draw press (56- by 60-inch bed) after blanking in another area. Although it is a mechanical press, it is equipped with a hydraulically operated blank-holder that is easily set to apply optimum pressure for the stock used.

One blank at a time is placed on a Sheffield shuttle (heading illustration) which automatically advances it into the draw die, then retracts.

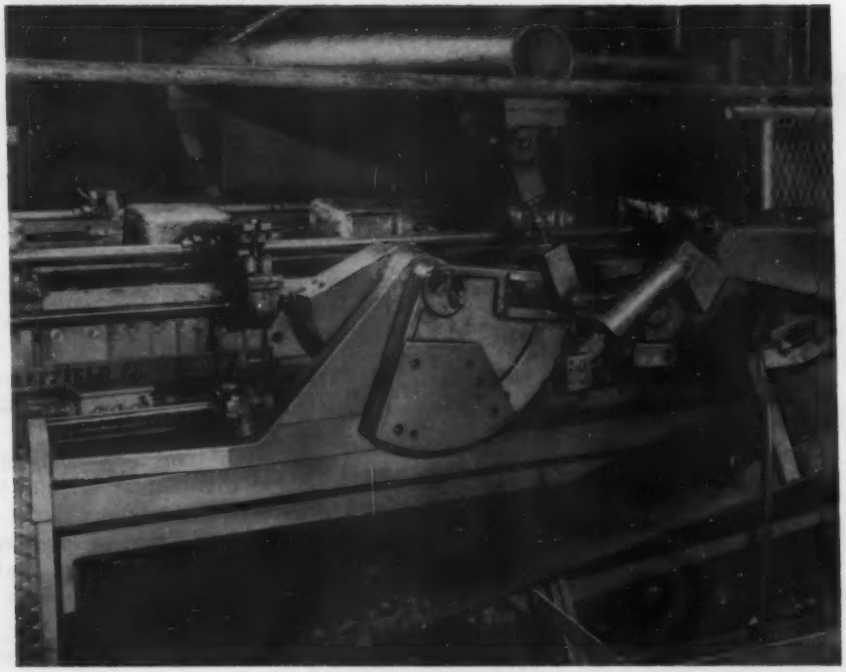


Fig. 2. Close-up of automatic transfer mechanism that carries the oil-pans through the final four presses. Press No. 2 actuates the entire mechanism. The safety guard has been removed for this illustration.

Fig. 3. Operator is about to trip the double-action press that draws front fenders for Buick automobiles. By using this mechanical loader, only one man is required to be in front of the press.

The press is tripped by two palm buttons, but keeps pace with subsequent presses. Hands of the operator are thus maintained clear of the die. DeVilbiss guns automatically spray each blank with drawing compound before the die closes. Taper pins in the die assure positive positioning of the blank should it not be located precisely by the shuttle. Only the 4-inch-deep major draw is made here, the rest of the blank remaining flat.

As the die opens, lift pins move the drawn piece upward and a Sahlin Iron Hand grips the stamping and pulls it from the die. Then, the stamping is dropped onto a belt conveyor (right, Fig. 1) for delivery to a transverse belt (foreground). This belt delivers the stampings to an operator at the head of the final oil-pan press line.

Ensuing operations are performed on four Clearing presses that make up this final line. A single Sheffield "Press Pacer" links them together. It includes a positive, automatic transfer mechanism with side bars actuated by racks and pinions, that extend through the line. Each side bar carries a series of fingers which move inward simultaneously to (1) grip all work-pieces in the line, (2) raise them to clear the dies, (3) advance all pieces one station, and (4) lower all pieces into a die or into some intermediate idle position. Part of the mechanism that operates the Pacer can be seen in Fig. 2.

Loading at the start of the line (Fig. 1) is done by an operator who controls all the presses. However, the line normally runs continuously with all presses making their working strokes simultaneously and at a set rate. A palm button permits the operator to stop the line instantly. It also can be stopped by a utility man who constantly watches the successive operations from various positions. Emergency stops are brought about by a pull on a cable that runs at head height along one side of the line, across the end, and back along the opposite side.

In loading for the first press, the stamping is placed (drawn portion up) in the first station of the transfer mechanism, which is well in advance of the die. Subsequent motions all are automatic. The 600-ton press completes the draw, bringing its maximum depth to approximately 5.4 inches and producing a shallow portion in the area previously left flat.

Before entering the second press in the line, a 250-ton unit, the piece passes through several idle stations. In this second step the flange remaining around the drawn portions is trimmed and a drain-plug hole is pierced, the slug dropping through the die. Offal from the flange is cut into two pieces and is diverted by air-operated pick-offs into scrap boxes, via inclined conveyors. This press also operates the transfer mechanism seen in Fig. 2.

After the trimmed part has been advanced through six idle stations, it enters the die in the next, or third, press which is of 600-ton capacity. There, a narrow return flange is drawn around the periphery, the main flange is flattened, and the radii next to the drawn area are reduced and brought to final size.

Again, the stamping is advanced through six idle stations before entering the die in the fourth and final press. This is another unit of 250-ton capacity. Punches in the die pierce all holes in the mounting flange and push the slugs through, completing the stamping operations. After being transferred out of the piercing die, the pan is dropped onto a conveyor and advanced through a washer.

Only three men are required to handle all five steps, two of them being press operators whose chief duty is loading, and the third a utility man whose chief duty is to watch the mechanized line, to see that it is stopped when necessary, and to make sure that troubles are corrected if they arise. Limit switches at each station determine if there is a work-piece seated in position. Should any of these switches remain open because of an unfilled station, the line will stop automatically.

Fig. 4. Fender draw die is viewed from the rear. Air-operated jaws swing into the die area, pick up the part, remove it, and place it on a roller table.

For several years, the shapes of Buick front fenders had made it necessary to preform and mash-seam-weld the blanks prior to drawing. This, of course, required extra machines and added labor, including that for handling the bulky parts, and tended to reduce economy of manufacture. Newly designed front fenders can be produced without preforming or welding the blank.

As before, blanks for drawing are produced in a separate area. They are then stacked on skids, or pallets, and delivered to the Danly press shown in Fig. 3. Eight-hundred tons can be applied by the blank-holder of this press, followed by 500 tons by the punch during the second action. Bed dimensions are 102 by 156 inches, which is greater than the present die requires, but which permits the use of larger dies should they be required for future models. Platens are designed for automatic die clamping to permit quicker die changes.

Although loading of the draw die with fender blanks (cut from 0.040-inch deep-drawing stock) is not completely mechanized, a mechanical loader is employed. Only one man is now used in front of the press, whereas two men were needed to load the preformed blank of the 1958 model. Stacked blanks are pushed, one at a time, onto the loader by hand. Use of this unit eliminates the need for body exposure under the die.

Dogs are moved in synchronism with the press to engage the blank and advance it across the rubber-tired rollers of the loader. They bring the blank into position against stops in the die and then retract. While this occurs, the operator has ample time to apply drawing compound to the next blank with a wide brush. When a blank reaches the draw position, the operator presses a palm button to trip the press.

Mounted on the back of the press is a Sahlin Iron Hand that swings in automatically when the die opens and the lifters elevate the drawn work-piece. Air-operated jaws grip the stamping, Fig. 4, draw it out of the die, and deposit it on rubber-tired rollers of the table seen in the right, foreground. An operator behind this table then picks up the stamping for transfer to the next press.

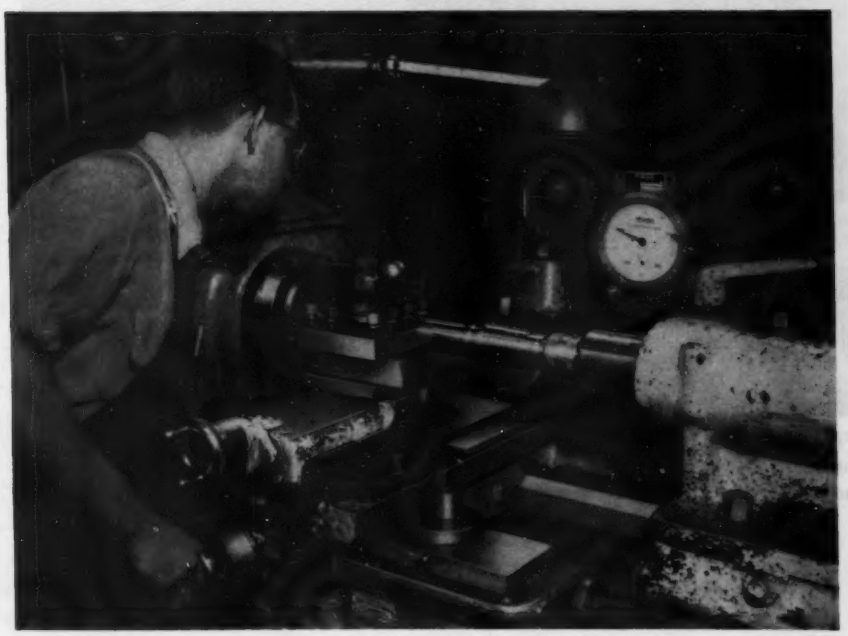
Largely because of the shape of the fender stamping, and because it must be subsequently presented in several different positions to presses of the horn and other types, it is not economically feasible to mechanize the remaining handling. Accordingly, it is done manually and with a minimum of movement. Mechanization of the draw presses, however, along with other economies, has proved to be highly beneficial in lowering over-all costs.

New Instrument Provides Direct Monitoring of Lathe-Tool Position

TURNING of multiple-diameter shafts is a significant part of the production picture in the transmission engineering department of the Allison Division, General Motors Corporation, Indianapolis, Ind. Many such shafts, ranging from 0.500 inch to 8.00 inches in diameter and from 4 to 48 inches in length, are needed for the company's extensive line of automatic transmissions for trucks, buses, and heavy-duty, off-the-road equipment.

Although the straight turning of step shafts did not, on the surface, appear to offer any particular manufacturing problems, there was one area in

Fig. 1. An accurate check on the longitudinal position of the cutting tool is continuously maintained by this Distometer. Each graduation on the dial face (large indicator hand) represents 0.002 inch of tool travel.



which improvement was needed to speed up the operation. This concerned rapid and accurate location of the many steps, and also the grooves for snap rings and seals, required along the shafts.

Action was taken by installing Federal Distometers on several of the lathes being used for the shafts. One of the units can be seen at the rear of a Monarch lathe in Fig. 1. It was found, after a considerable period of time had elapsed, that a decrease in over-all production time of approximately 27 per cent was being consistently obtained on these few machines.

A new instrument, the Distometer, provides the lathe operator with a fast and reliable means of spotting tool position and directly measuring longitudinal cutting distances without the need for measuring rods, hand scales, or optical devices. The unit is attached to the rear of the lathe carriage, thereby traveling with it at all times. This not only maintains a fixed relationship between the cutting tool and the instrument, but also assures that both will have the same range of movement.

Two indicator hands are carried on the clock-size dial. The large, centrally located hand covers a range of 0.500 inch of carriage travel in one revolution and its scale is broken down into graduations representing increments of 0.002 inch. One revolution of the smaller hand, however, records 5 inches of carriage movement with the dial divided into segments representing 1/2 inch.

One of the main features of the Distometer is its provision for push-button zeroing. The indicator can be referenced instantly at any point in its range of travel, and can measure the tool movement continuously to any other point whether it be for the cutting of shoulders, grooves, or bores.

Movement of the cutting tool with respect to the work is sensed by rollers within the instrument. These rollers pinch against a stationary steel tape that passes through the unit, and their rotation actuates the gage mechanism to indicate the actual distance traveled by the carriage. The tape is stretched taut behind the lathe bed. One end is anchored to the headstock housing and the other end to a bracket on the tailstock end of the machine, Fig. 2. By means of the steel tape (which can be cut to any desired length) the instrument is provided with an unlimited range and, therefore, can be used on any lathe regardless of bed length.

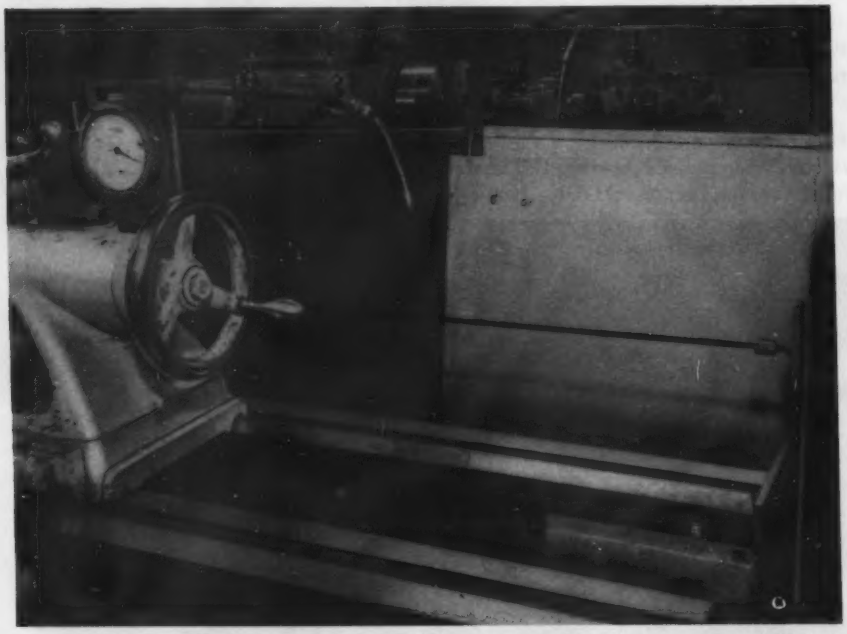


Fig. 2. Change in tool position is sensed by movement of the instrument (which is attached to the rear of the carriage) in relation to this stationary steel tape. The tape passes through the indicator housing and is anchored at both ends of the lathe.

One Furnace— Two Quenches

A single "two-headed" furnace designed for service in overseas plant of an American hacksaw-blade manufacturer is capable of bright-hardening two different types of tool steels

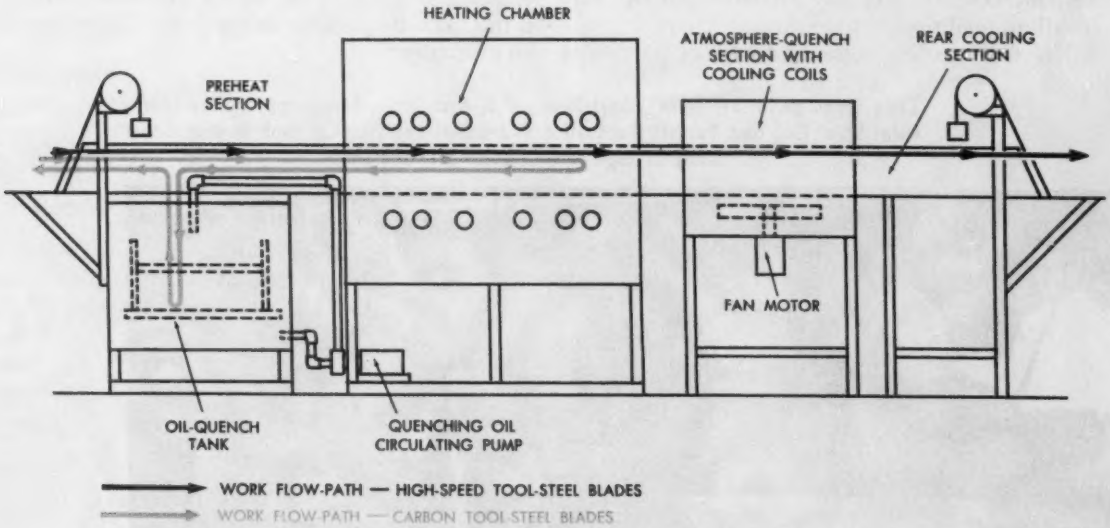
CARL G. PAULSON
Director of Research & Development
C. I. Hayes, Inc., Cranston, R. I.

A PUSHER TYPE furnace that features both atmosphere- and oil-quenching facilities has been developed by C. I. Hayes, Inc., Cranston, R. I., for the production hardening of power and hand hacksaw blades. Distinctive in its ability to harden carbon tool steels, as well as high-speed tool steels, this Dual-Quench furnace employs ceramic heating elements and has a special refractory heating chamber suitable for temperatures up to 2400 degrees F. The hacksaw blades, depending on the type, pass through the furnace in either the straight-line or in-and-out flow pattern shown in the accompanying illustration.

In hardening, high-speed steel blades are placed on edge in racks and pushed through a loading vestibule into the heating chamber. The gas to air ratio control on the endothermic generator is set to supply a low dew-point protective atmosphere to the furnace and the temperature is held at approximately 2350 degrees F.

After the heating cycle is completed, the work is advanced into an atmosphere-quench section which contains fins, baffles, water cooling coils, and a high-velocity, impeller type fan. Here the tray holding the work is supported on rails to promote a free, rapid circulation of the cooling atmosphere through and around the blades. The blades are then passed through a water-jacketed cooling chamber and are discharged at the rear of the furnace. Proper hardness is obtained through accurate control of both the temperature and the atmosphere dew point, and by employing a rapid atmosphere quench.

Carbon-steel blades follow the in-and-out flow pattern shown in the illustration. They are loaded on trays and advanced through the vestibule into



Arrangement of hardening furnace featuring both atmosphere and oil quenches. High-speed-steel hacksaw blades pass straight through furnace while carbon-steel blades follow the in-and-out path.

the heating chamber in the same manner as high-speed-steel blades. The temperature and atmosphere dew point are controlled to maintain the values dictated by the type of steel being treated.

After soaking for a specified time, the work is retracted into the vestibule and quickly dropped by means of an air-actuated elevator into the oil-quenching bath. An important feature of the furnace is that the work is retained under atmosphere throughout the full traverse from heat to quench. In addition, the quenching bath is constantly circulated by pump through thermostatically regulated heat exchangers. This system allows the recommended temperature to be maintained uniformly from the top to the bottom of the quench tank. As in the atmosphere-quench section, work trays are supported on rails during the quenching phase, to assure maximum circulation of oil around the blades.

When the elevator is in the down position, the opening to the quench tank is covered, making it possible to push the next work load into the heating chamber while the previous load is being quenched. The quenched load subsequently can be removed through a side opening in the quench-tank cover. This design eliminates the danger of upsetting the dew point of the furnace atmosphere during the removal of work.

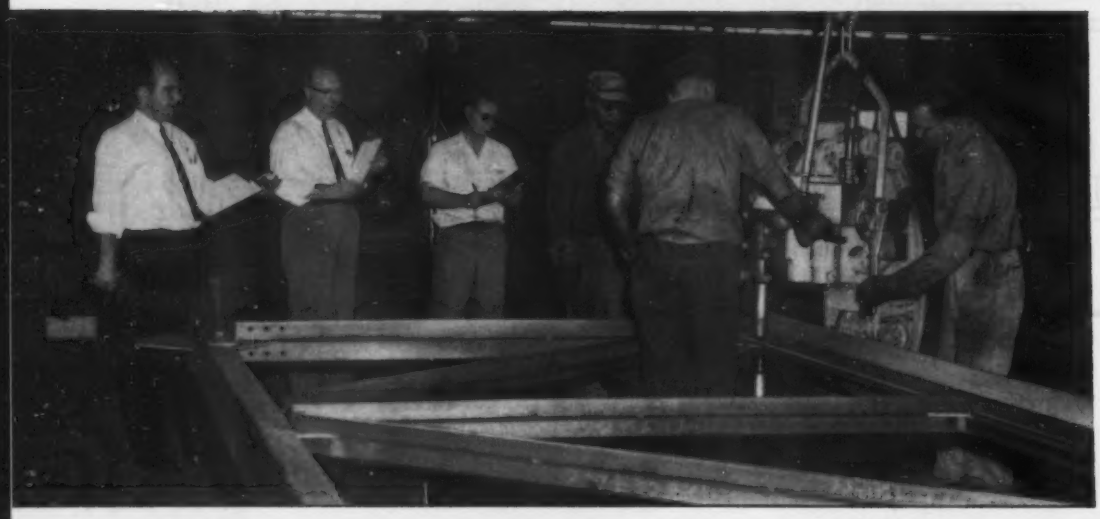
In addition to the dual-quench arrangement, the furnace employs baffled ceramic heating elements which distribute the heat uniformly. It is equipped with temperature controls, power controls, and automatic water controls to facilitate operation. This Dual-Quench furnace is a standard production unit which has been modified for the specific hacksaw-blade application. The two-quench principle, however, has a wide range of application for other types of work.

Steel Fabricating Productivity Advanced by High-Tensile Bolting

Extensive studies in the economics of high-tensile bolting of structural steel members in fabricating shops were recently made by the Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y.; the Mississippi Valley Structural Steel Co., Melrose Park, Ill.; and Albert Ramond & Associates, consulting engineers of Chicago, Ill. These studies indicate that shop bolting results in an unprecedented amount of tonnage per man-hour without necessitating any increase in shop size, handling facilities, or work force.

The findings are believed to be of particular import to fabricators caught between rising cost trends and competitive pressures from producers of reinforced and prestressed concrete. The study also evaluated the effect of new developments in bolting said to be coming in the near future. The probable introduction early in 1960 of high-tensile bolts with a larger area under the head than present bolts will make possible the elimination of one washer in each fastening, and perhaps two washers. Because of the higher tensile-shear ratio, it may also be possible to use fewer fastenings in an assembly.

Time study engineers from Albert Ramond & Associates, Mississippi Valley Structural Steel Co., and Russell, Burdsall & Ward Bolt and Nut Co. took part in a cost study of high-tensile bolting in the shop.



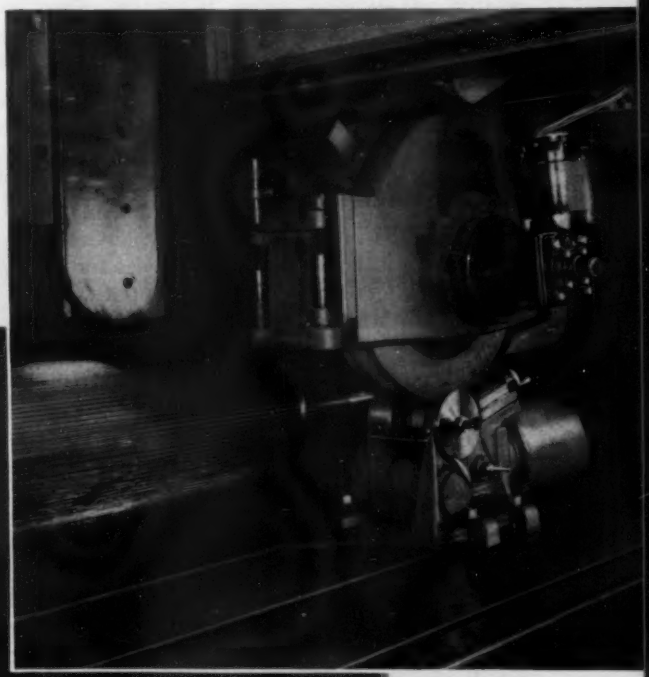
GRINDING SPECIAL ROLLS *with Crush-Trued Wheels*

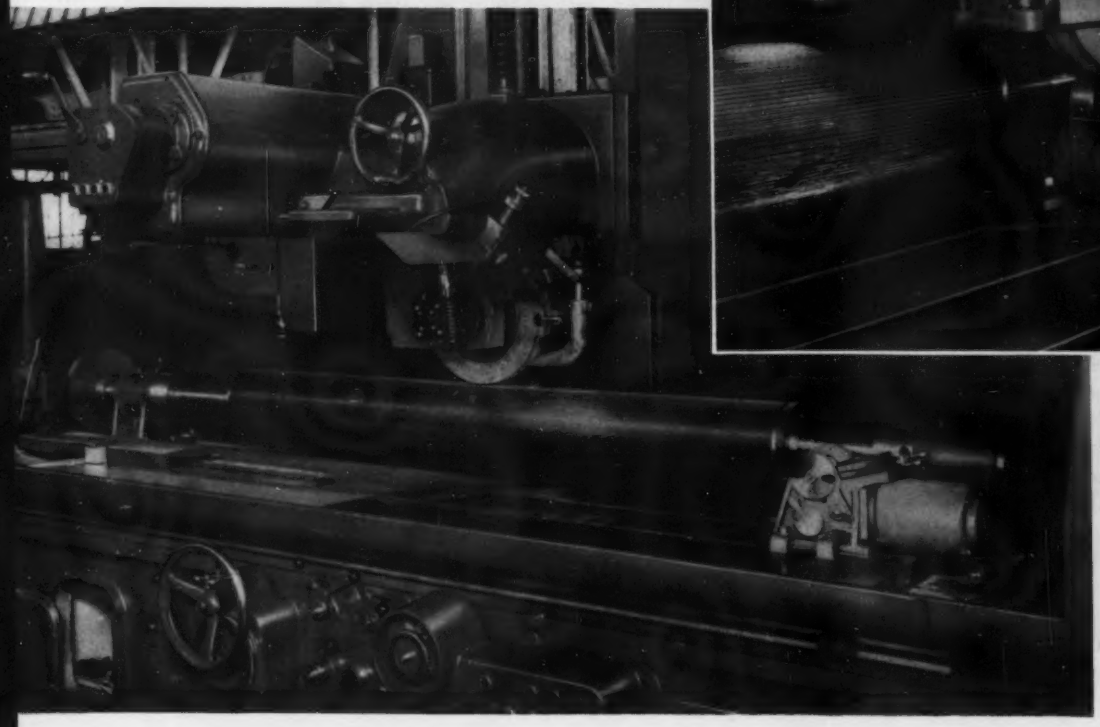
ROLLS for many purposes can be ground to the required shape by either a single or repetitive application of a crush-trued wheel. Annular profiles that do not require undercutting or straight side walls, or those which do not extend too deeply into the periphery of a forming roll, are readily produced by this method. Similarly, however, longitudinal profiles can also be ground in rolls. This may be done on a horizontal-spindle surface grinder equipped with both a crush-truing device and a means for indexing the roll. In the illustrations, a Mattison grinder and Sheffield "Crush-true" equipment are shown set up for grinding longitudinal serrations in a steel roll.

The profile is produced by repeated application of the grinding wheel, the roll being indexed between operations until the profile is complete. When the crush-formed wheel requires truing, it is rotated in contact with the crushing roll mounted on the machine table. This device, seen at the right in both illustrations, is motorized and has a flat carbide form tool to shave the crushing roll to the proper shape as it becomes worn. The motor of the device has two speeds, one for shaving the roll and the other for crush-truing the wheel.

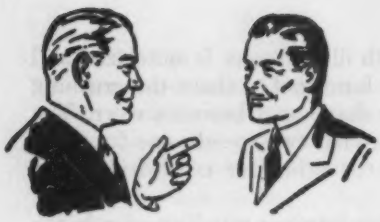
Devices for crush-forming grinding wheels are made in idler and motorized types. The idler type is used on grinding machines equipped with a slow-speed spindle drive. They are chiefly employed for crush-dressing shallow profiles on narrow-face wheels. Where wide wheels and deep forms are involved, a motorized fixture is generally used.

Another method of dressing crushing rolls is accomplished by mounting both a master and crushing roll on the machine table. After the crushing roll has been worn slightly, the master roll is used to dress the wheel once. The wheel is then used to grind the crushing roll to shape.





Wheel being crush-trued (close-up) for crush-form grinding (below) of longitudinal serrations in a special machine roll. Crush-truing device is motorized and has flat carbide form tool for shaving the crushing roll.



Talking With Sales Managers

BERNARD LESTER
Management Consulting Engineer

Pretest— to Prevent Failure

ONE of our correspondents points out troubles met in marketing a new type of machine. He has suffered a severe setback in selling a newly designed and well-promoted metalworking tool and asks about hidden causes. His question: "How can I make reasonably sure that my new machine won't prove to be a dud?" The causes for failure were not immediately manifest, but it soon developed that this machine had not been completely pretested.

To many, pretesting implies merely trying out the prototype for performance. We ordinarily visualize models on test and record charts, but pretesting is also a necessary commercial function that involves different methods. For instance, to pretest a product may be to cast its image on prospective markets and study conceivable marketing procedures.

A "No Man's Land" often exists between technical and commercial pretesting which escapes attention. Pretesting must be comprehensive and include the visualization of every condition from determining customer taste to the reliability of a lock-nut in the mechanism to be sold.

The story behind the struggle to develop each successful machine is a fascinating drama and for each drama of this sort there are many unwritten tragedies. Analysts are quick to account for failure of a spectacular product. Last year, when a widely publicized automobile was rushed out on the sales track, it promptly stalled. Critics hastened to explain the cause. Every hindsight study of product failure demonstrates the enormous advantage of pretesting.

Studies of the wreckage of newly exploited industrial equipment show four main sources of market failure which emphasize the value of pretesting a new product to insure against loss.

Time, or Birthday of the Machine——Each year, some new designs are anachronistic—born too early or too late. There is no chance for the machine that is born too late. The one born prematurely may live, but be costly to raise. The responsibility of timing a new product rests heavily on the sales department. Who can better foretell the buyer's needs and figure out his requirements at the time the new machine is to be ready? Pretesting to define customer opinion can well supplant mere hunch.

Design——Most modern machines are salable because of inherent design features such as size and weight, ability to do accurate work, and automatic or inclusive operating features. Few machines fail to sell because of low quality in materials or workmanship. As a result of violent change, the graveyard of metalworking is made up of obsolete, not worn-out, equipment, Pretesting of a proposed design, therefore, includes an imaginative sounding out of what customers lack and want.

To be able to detect design trends is vitally important to any machinery builder. For instance, in our craze for the bigger and more automatic, we may be approaching a point of diminishing return. Are we alive to changes in business climate which may well deflate the market for mass-production machines? A lush-times design may be an outcast in an economy era.

Sales—Service——New machines sometimes fail to "sell" because they are not marketed, sold, and serviced "right." Many of us have lost position, cash, and time from adopting a traditional sales-service plan for a novel product. We get attached to a sales-service habit as we do to an old hat. We must pretest if we are to excell in sales and service.

Competition——Competition is not an offensive wall to be met with defensive strategy. Competition is agile and hard to anticipate. Busy with his own equipment, the sales manager may neglect to use pretesting tactics on what the other fellow sells and how he sells it. Of course, design and production departments try to outdistance competition. But the sales department must be convinced that the new machine is not only competitive but can be sold efficiently according to a plan that predicts every move.

Supremacy in the future will more and more depend on new designs and new methods of selling and servicing. The experimental laboratory of the mind, using the principles of repeated pretesting, will account for many improvements by equipment manufacturers during the new decade.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Circular Knife-Edges Locate and Grip Thin Castings

H. J. GERBER, Stillwater, Okla.

Holding a thin casting in a fixture while surface milling can often be a problem, as it usually is not possible to apply clamps against its top surface. One solution to this problem is presented in the accompanying illustrations.

A small cover-plate casting *A*, Fig. 1, is positioned against three circular knife-edge locators *B*. Two hardened screws *C*, their ends ground to sharp points, pass through block *D* at a downward-pointing angle. The sharp points contact the casting, forcing it against the two side locators while seating it firmly against the fixture base. The third knife-edge is at the end of the casting to oppose the feeding force of the cutter.

Fig. 1. (Above) Fixture uses three circular knife-edges (B) to locate and grip thin casting (A) while surface milling.

Knife-edge locators of this type will bite into the surface of the casting and prevent it from lifting during the cut, regardless of the draft angle encountered. They should be made of tool steel, then hardened and tempered to approximately 58 to 60 Rockwell C.

The circular shape is particularly advantageous as it permits periodic rotation of the locators when one portion of the edge becomes dull from repeated use. They are secured to the fixture base by socket-head cap-screws to permit quick release when it becomes necessary to turn them. The fixture is shown removed from the milling machine in Fig. 2.

Fig. 2. (Right) Sharp-pointed screws (C), positioned at an angle, force the work-piece against the side locators and down on the fixture base.

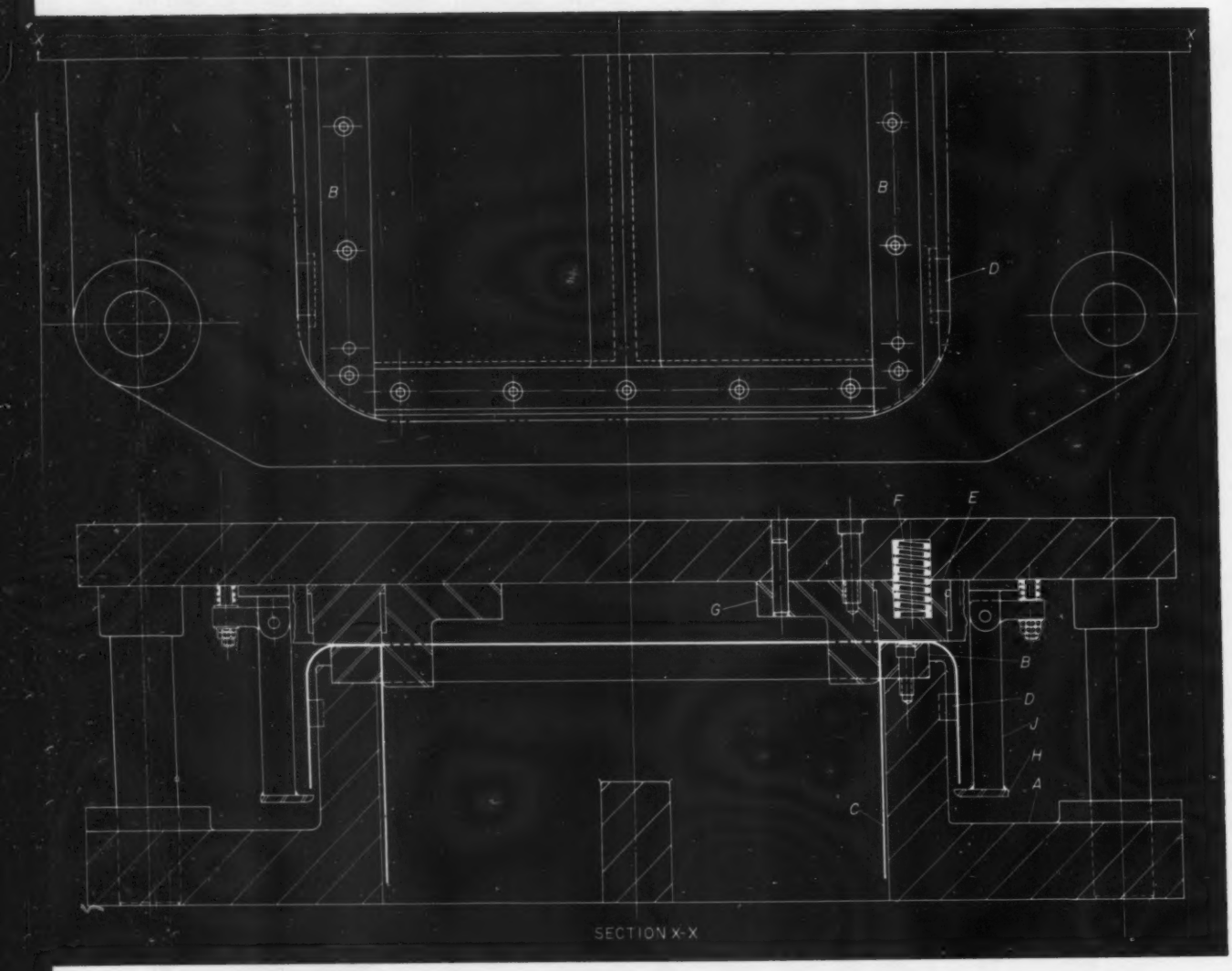
Form Die for An Unusual Part

ROGER ISETTS, Kenosha, Wis.

The shape and size of a heat-exchanger shroud 2 1/2 feet square made the application of a standard die set for bending down two flaps on the part impossible. Instead, the special four-post die set here illustrated was designed and used for the operation.

Made from a good grade of cast iron, the lower member of die set *A* has a large square cored opening in the center. A heavy rib extends across this opening to add strength. The lower member of the die is machined on two sides to receive form-blocks *B*. These blocks are made of hardened and ground tool steel and are secured to the die set with screws and dowels. The other two sides are machined to fit the contour of the work-piece *C* and serve to locate it in the die, front to back. Four hardened locator pads *D*, secured to the side of the die with socket-head cap-screws, position the part, left to right.

In operation, the part is first placed over the locators. As the press ram descends, four hold-down rails *E* are actuated by springs *F* to secure the work in place. Then, two forming punches *G*, which are bolted and doweled to the top die



Die for performing a bending operation on a part of unusual shape. The symmetrical work-piece is too large for the use of a standard die set.

member, fold the flaps down into the center cavity of the die. Prior to bending, the flaps are in the position indicated by broken lines in the plan view. On the up stroke, two strippers *H* hook under the part and lift it out of the die. These strippers extend along two opposing sides of the workpiece. They are supported in place by rocker arms *J* which are welded to each end.

Device for Drilling Two Small Holes Close Together

ERNEST JONES, New York City

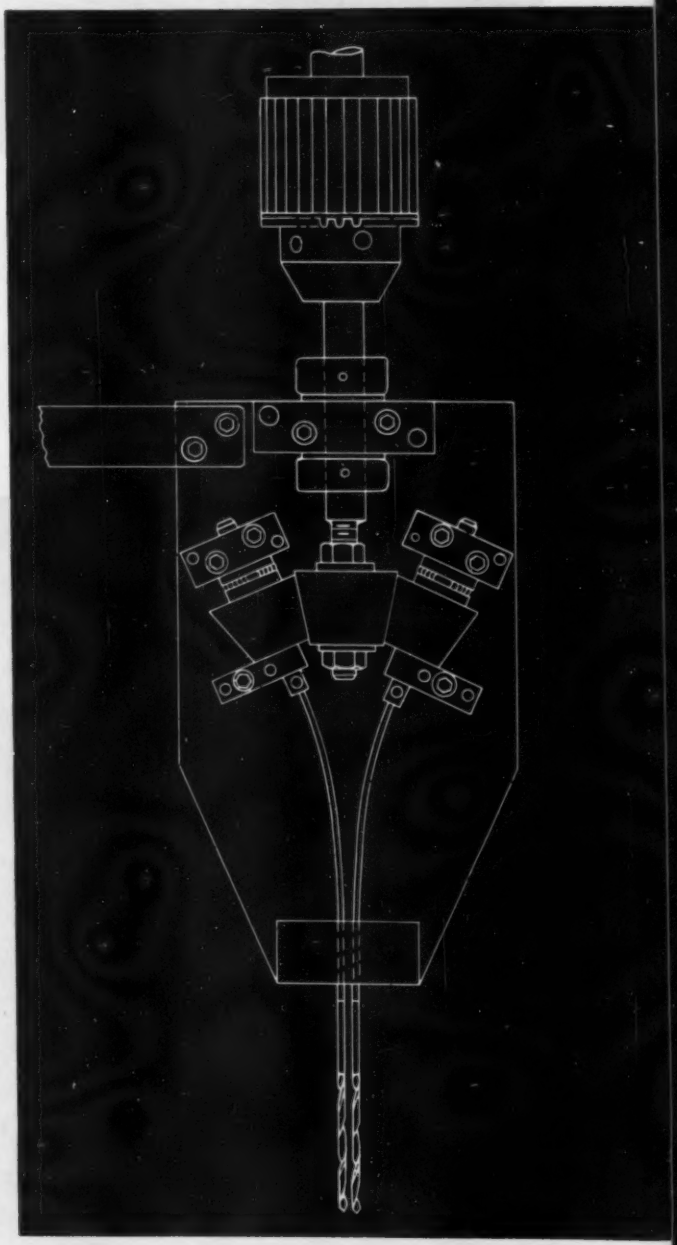
In a production job it was necessary to drill two 5/64-inch holes close together and for economical reasons it was desirable to produce both holes simultaneously. The unique device here illustrated was designed to meet these requirements. It can be driven from a conventional drill chuck.

The various components are mounted on an aluminum plate. There is a central drive-shaft that is supported in two bronze bearings and carries a tapered neoprene roller at the lower end. This roller is mounted between two washers and nuts in such a way that it can be adjusted axially to provide good contact with two driven rollers on individual spindles. The drive-shaft is retained axially on the aluminum plate by collars and bronze washers.

The driven rollers are also made of neoprene. The shafts on which they are mounted run in bronze bearings and are also provided with ball thrust bearings to take end thrust as the drills are fed into the work. Each driven shaft is drilled and tapped to receive a set-screw which is tightened against a flat on the end of the corresponding drill shank to securely lock the drill to its driving component.

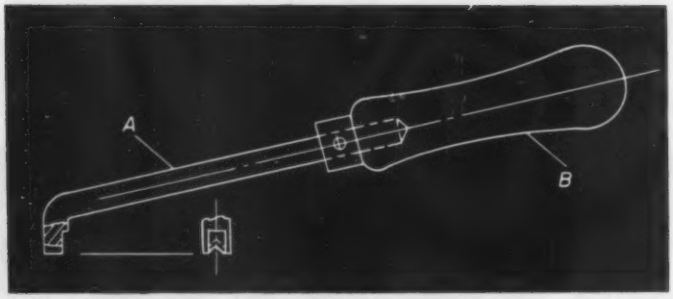
The shanks of drills selected for use with this device are turned down for a short distance and soldered in long extension shanks. The shank extensions should be made of drill rod so as to provide for long life, there being a constant reversal of stresses as the drills whip around during rotation. Extra drills soldered on extension shanks are kept on hand for quick replacement. The entire unit can be enclosed with a cover made of sheet metal or plastic sheets. A bar fastened to the aluminum plate projects from the device to the column of the drill press and thus prevents the unit from rotating with the machine spindle during an operation.

Either the rotation of the drilling machine must be reversed from conventional practice in using this device or else left-hand drills must be employed. If the device should be designed for larger drills than 5/64 inch, the height of the unit must be increased somewhat so as to avoid too sharp a bend in the drill shanks.



Unique device designed for simultaneously drilling two small holes close together.

SHOP KINKS



Simple tool that is convenient for deburring metal sheets.

Handy Deburring Tool

F. MURRAY, Chicago, Ill.

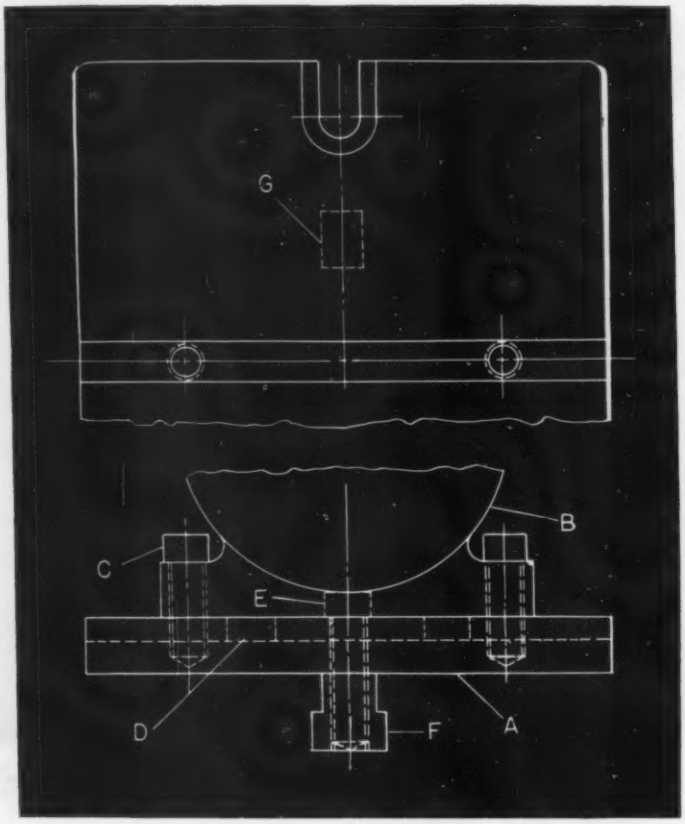
Burrs on the edges of metal sheets can be removed in a minimum of time by using the tool here illustrated. One end of a piece of drill rod *A* is bent as shown and provided with a 90-degree notch. The sides of the notch are relieved for clearance. After the cutting end is hardened, the device is completed by mounting the rod in a file handle *B*. In use, the notched end of the tool is pulled along the edges of the metal sheets to cut off any burrs. A handle made of a piece of tubing or rod may be welded or brazed at right angles to the tool near the cutting end for convenience in applying the necessary pressure.

Adapter Plate for Easy Mounting of Dividing Head

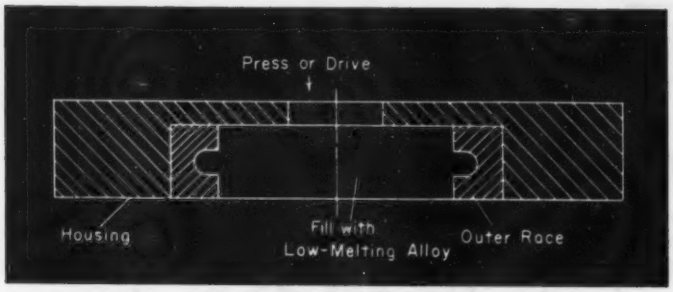
FRANK L. RUSH

Occasionally, the spacing of the T-slots on the work-table of a milling machine will not permit a dividing head to be bolted in place directly. Use of the adapter plate here illustrated will readily overcome this situation.

Adapter plate *A* is provided with two tapped holes for the bolts *C* that hold the dividing head *B*. In addition, a slot is machined along the center of the plate to receive keys *D*. These are located on the bottom of the dividing head. Two open-end slots at right angles to the keyway allow the adapter plate to be secured to the machine table. This is accomplished by means of bolt *E* and T-nut *F*. For location purposes, two keys *G* are secured by cap-screws to the bottom of the plate and in line with the open slots.



Adapter plate for easy mounting of a dividing head in cases where T-slot spacing does not permit direct bolting.



Outer bearing race can be removed by filling the cavity with a low-melting-point alloy, then driving it out from the rear.

Removing a Bearing Race from a Counterbored Hole

ROBERT H. DALTON, Roseville, Mich.

One of the most difficult situations encountered when removing a badly damaged bearing from a counterbored hole is when the inner race and balls drop out, leaving the outer race seated in the housing. Removal of the outer race (see illustration) can be simplified, however, by first filling the cavity with a low-melting-point Cerro alloy or solder. When the material has solidified, it and the bearing race can be pressed or driven out from the rear.

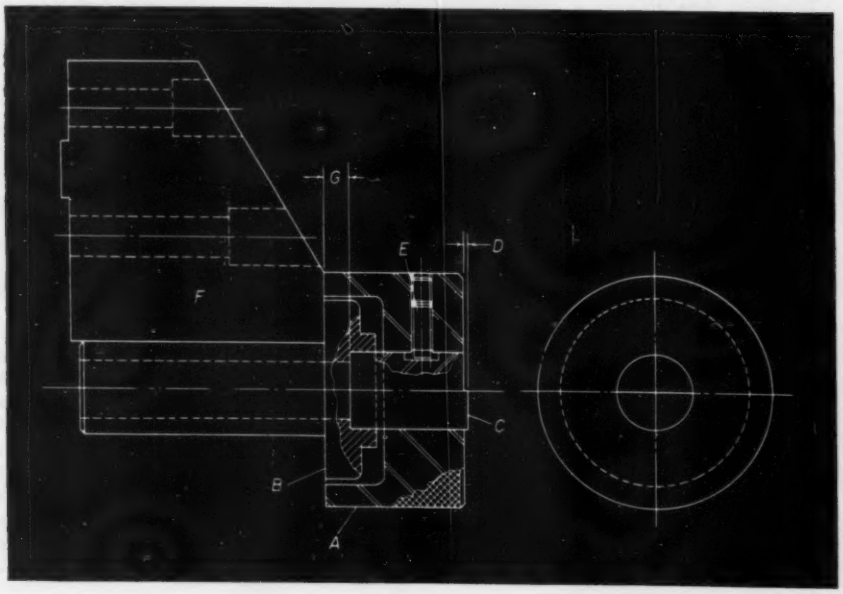
Gage Checks Work in Machine

ROGER ISETTS, Kenosha, Wis.

Often, when running work in a lathe, it is necessary to hold a bore or drilled hole to a specific depth in relation to the back face of a flange. In most cases this rear flange face is against the chuck jaws. Removing the part for gaging, and then rechucking it if not correct, requires considerable time. This procedure can be eliminated with the illustrated gage. It is a simply designed device that makes use of the chuck jaws as a contact surface.

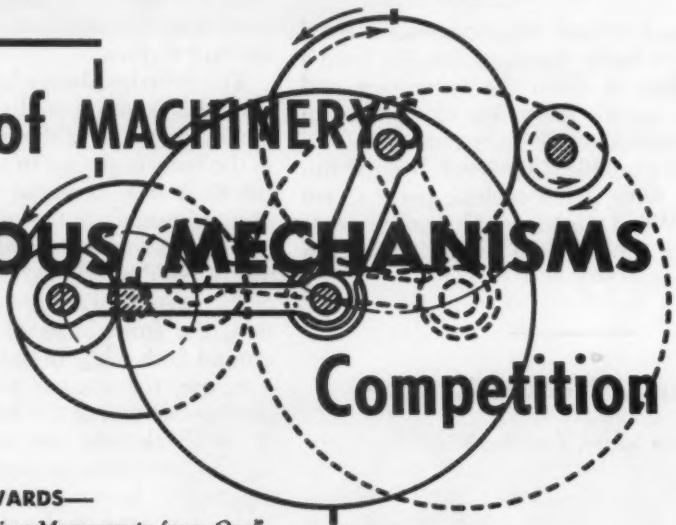
The cylindrical gage has a hardened-steel body *A*, and is counterbored in front to clear the projecting portion *B* of the work-piece. A central hole in the body is ground to a slip fit to receive gaging pin *C*. A step *D*, equal to the work-piece tolerance, is ground on the outer end of this pin. The pin is retained by a dog-point set-screw *E*. To assure the desired degree of accuracy, both ends of the gage body are ground parallel and, in addition, the front faces of the chuck jaws *F* are ground flush while in the machine.

In use, the gage is placed over the work as shown—one end of the body contacting the faces of the chuck jaws, and the inner face of the gaging pin bottoming in the counterbore. By feeling the step on the outer face of the pin, the operator can tell at once if the opening has been cut to the correct depth *G*.



Simple, cylindrical gage (A) utilizes flush pin (C) to check depth of counterbore in relation to back face of flange. This is done without removing the work-piece from the chuck.

Winners of MACHINERY'S INGENIOUS MECHANISMS Competition



These awards have been made by the judges of MACHINERY's Ingenious Mechanisms Competition which closed on December 1, 1959.

"GYROSCOPIC GRINDING SETUP"

J. BOAS POPPER, *Kiryat Mozkin, Israel*

$300

——for a unique and practical application of the gyroscopic precision principle to the grinding of diamond phonograph styluses.

"MECHANISM FOR DRAWING CONIC-SECTION CURVES"

THOMAS R. GOULDEN, *Glasgow, Scotland*

$200

——for a complete machine incorporating simple mechanical components arranged for drawing parabolas, hyperbolas and ellipses.

FOUR $50 AWARDS——

"Two Reciprocating Movements from One"
L. Kasper, Philadelphia, Pa.
"Supports Advanced Proportionally on Same Lead-Screw"
H. B. Schell, Brooklyn, N. Y.
"Reversing Two-Speed Geneva Drive"
Sigmund Rappaport, Long Island City, N. Y.
"Selective Two-Position Slide Movement"
Preben W. Jensen, Orange, N. J.

"DUAL-FEED FIRING MECHANISM"

EDWARD B. SMITH, *Burlington, Vt.*

$100

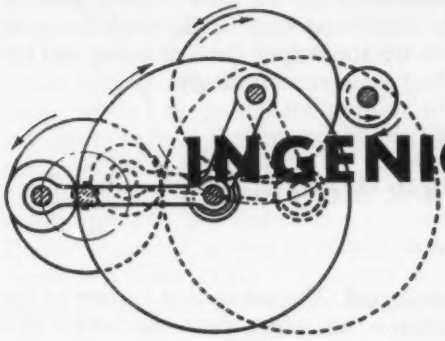
——for a compact rearrangement of existing ordnance components to provide a simultaneous dual feed for a six-barrel firing device.

HONORABLE MENTION——

A considerable number of excellent articles were submitted in the contest. Honorable mention was awarded to articles submitted by the following:

Edward F. de Zabala	Toronto, Ontario
Corning, N.Y.	Michael B. Blunn
Ralph T. Stewart	West Collingswood, N.J.
Winston-Salem, N.C.	John A. Vernon
Hideo Suzuki	Philadelphia, Pa.
Tokyo, Japan	Richard Marsh
Hugh M. Foster	Lima, Ohio
Riverside, Calif.	Ernest E. Novel
Edward D. Bennett	Geneva, Switzerland
Union, N.J.	Vincenzo Negri
George G. Siposs	Trieste, Italy

Prize-winning articles, as well as those receiving honorable mention, will be published in the Ingenious Mechanisms Department during the coming months. This department—a regular feature of MACHINERY since 1927—is an invaluable aid to designers. It contains articles describing mechanisms or movements that can be applied in designing automatic machines and other devices that differ widely in purpose. Contributions are always welcome and MACHINERY's high-level space rates will be paid for all acceptable articles. Many of these articles are later compiled and reprinted in book form for permanent reference (*Ingenious Mechanisms*, Vols. I, II, and III, published by The Industrial Press).



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Dial's Moving Witness Mark Compensates for Backlash

CLINT MCLAUGHLIN, Rockaway Beach, N. Y.

A moving witness mark on a dial controlling the angular position of gears, feed-screws, or levers solves the problem of discounting the influence of any backlash. In Fig. 1, the device is shown from the front and side. Dial *A* is fixed to shaft *B* which feeds into the machine or mechanism involved. The witness mark is scribed on plate *C*, which in turn is attached to hub *D* mounted on, but not fixed to, shaft *B*. A blind hole cross-drilled in the hub contains spring *E* and friction pad *F*. The pad drags against the shaft, transmitting the torque from the shaft to the hub. Adjustable stops *G* limit plate travel.

In each view, Fig. 2, the dial is set at 30. In View A, the setting was made by rotating the dial counter-clockwise, while in View B, the dial has been rotated clockwise. Although the settings are the same, the dial in each instance is in a slightly different position, as is the witness mark. This difference is due to the backlash in the system between the dial (the input) and the gears, feed-screws, or levers (the output).

If the dial in View A is further rotated counter - clockwise, the output motion will follow the input motion directly and immediately because

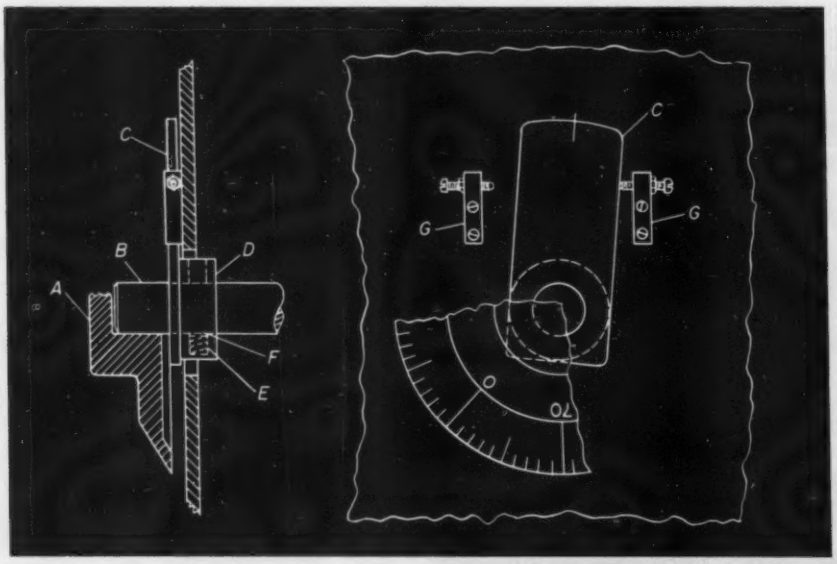


Fig. 1 (Above) The free movement of plate (C) between the dogs (G) equals the amount of backlash in the system that has to be taken up.

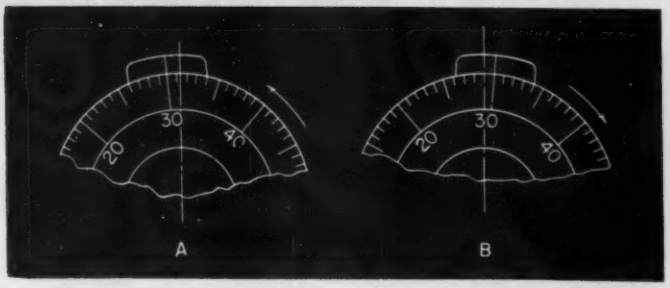


Fig. 2. (Right) Backlash in the system accounts for the slight difference in the angular disposition of the two dials and witness marks.

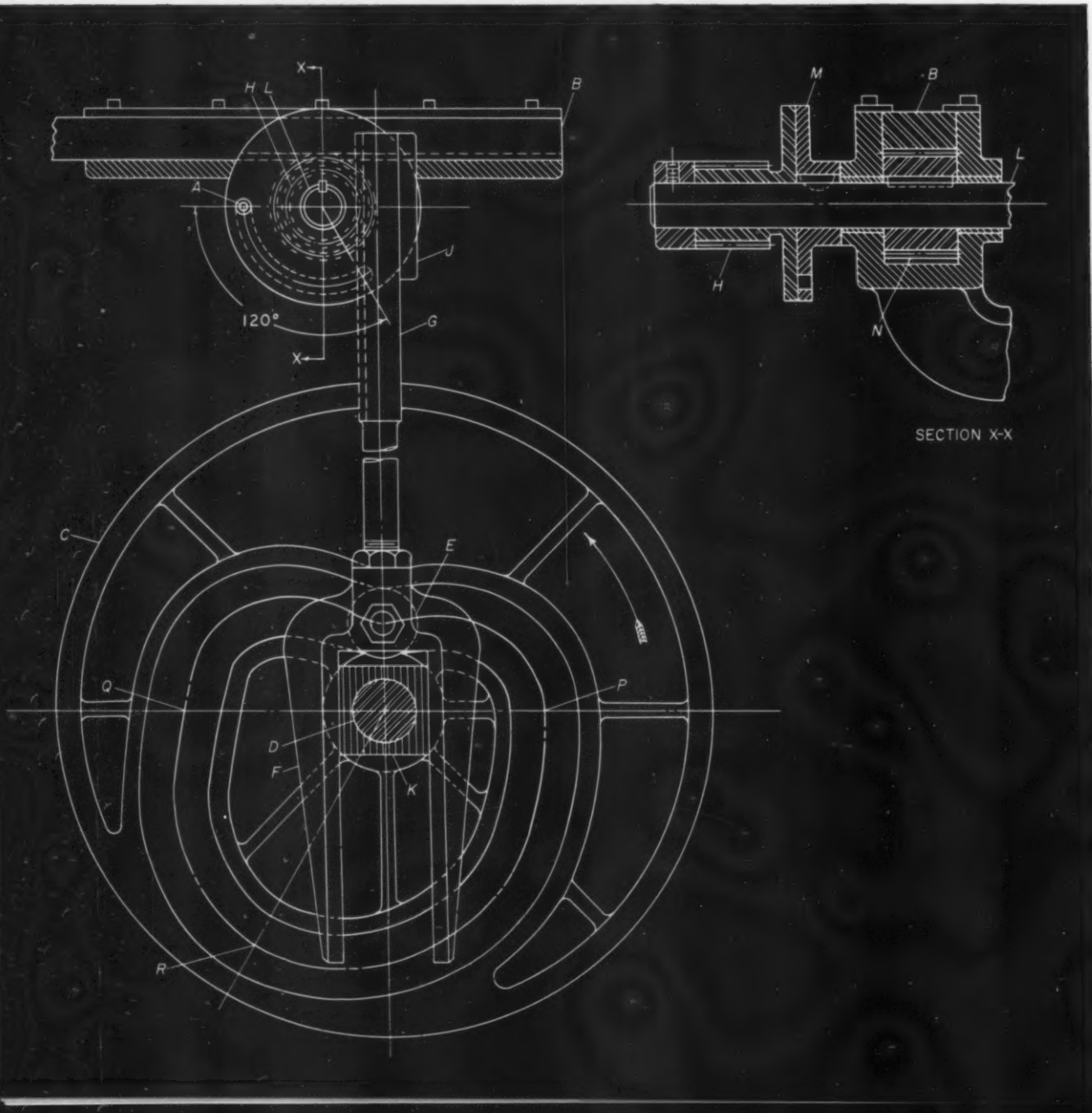
the backlash has been taken up in this direction. But if the same dial is rotated clockwise, the input motion is not transmitted until the backlash has been taken up. As the dial moves clockwise, the witness mark moves with it until plate *C* abuts the right-hand stop *G*. Backlash has now been taken up, the output starts to move, and the dial reading changes accordingly.

Cam Eliminates Shock in Rack Movement

RALPH T. STEWART, Winston-Salem, N. C.

An arrangement that imparts a rapid intermittent and reciprocating movement to a rack employed in an aluminum foil bag-making machine is here illustrated. The interesting feature of the mechanism is a cam which slows the motion of a drive-pin *A* each time it is about to contact a disc

Arrangement that incorporates a cam to prevent excessive shock in an intermittent, reciprocating rack movement.



and move the load. This deceleration prevents undue impact loading and possible breakage of the pin. Since the load, rack *B*, and its drive were added subsequent to the construction of the machine, limited space and the position of existing members were major considerations governing design of the device.

A face-cam *C* is keyed to a drive-shaft *D* which existed prior to the modification of the machine. Roller follower *E* is free to rotate on a stud secured to a slider guide *F*. One end of the slider guide is turned and threaded for assembly to a rack *G*. A lock-nut secures the assembly in the proper position. Rack *G* is restrained to a vertical linear motion by a pinion *H*, guide *J*, and a stationary slider *K*, the drive-shaft *D* being a running fit in the slider. The pinion *H* is in mesh with rack *G*, and is free to rotate on a shaft *L*.

A disc integral with pinion *H* carries drive-pin *A* which is located in a 120-degree circular slot in an adjacent disc *M*. Disc *M* and a pinion *N*, which is in mesh with the guided horizontal rack *B*, are keyed to shaft *L*. Thus, if pinion *H* is rotated counterclockwise, pin *A* will traverse the circular slot and contact disc *M*. Further motion in the same direction will be transmitted through disc *M*, shaft *L*, and pinion *N* to drive rack *B*. Reversal of rotation of pinion *H* will again cause the drive-pin to traverse the circular slot before contacting disc *M* to drive the load in the other direction.

The rotational speed of pin *A* at impact with disc *M* is controlled by the path of the slot in cam *C*. If the rotation is not reduced to a minimum at the moment of contact, the resulting additional impact loading could cause breakage of the pin. Minimum impact is obtained by making the incremental radial rise of the cam-slot as small as possible in the areas of points *P* and *Q* which are traversed by the follower at the two moments of contact. In addition, cam *C* is designed to impart the movement necessary for rack *B* to complete its function in the machine.

In operation, cam *C* is rotated counterclockwise. The rise imparted to the vertical rack during the first 90 degrees of rotation of the cam traverses pin *A* through the 120-degree slot in disc *M*, rack *B* remaining stationary. When the center of the follower coincides with point *P* on the cam, pin *A* is in contact with disc *M*. For the next 120 degrees of cam rotation pin *A* moves to the horizontal rack to the left. Reversal in the rotation of the pin occurs when point *R* of the cam coincides with the center of the follower. Again, rack *B* is stationary as the pin traverses the slot in disc *M* clockwise during the following 60-degree movement of the cam. Pin *A* contacts the disc when the follower is at point *Q* and returns rack *B* to its initial position in the final 90 degrees of cam rotation. At both points *P* and *Q* the rate of rise or fall of the follower is at a minimum to prevent impact damage to the pin. This mechanism is used to provide the movement necessary to place a piece of thermoplastic tape on aluminum foil bags for reinforcing and sealing purposes.

Filler Metal Conversion Charts Revised

The American Welding Society announces a revised forty-eight-page booklet containing the most complete set of welding-rod and electrode-conversion charts ever published. The brand names of seventy-eight companies are listed. Fifteen AWS-ASTM specifications are involved, and brands, as well as manufacturers' names, are cross-referenced in two indexes.

With the aid of the comparison charts it is possible to see at a glance in which classification a filler metal belongs, irrespective of the brand name or number. The importance of correct classification of brand names is brought out by the fact that seventy-eight manufacturers of filler metal submitted information for this issue, against the sixty who contributed to the last issue. Copies may be obtained at a list price of $2.50 from the American Welding Society, Dept. T., 33 W. 39th St., New York 18, N. Y.

How Industry Supports Education

In 1958, U. S. colleges and universities had an estimated income of $4.4 billion, of which more than $850,000,000 came from voluntary contributions, including about $136,000,000 as direct gifts from corporations.

A recent survey shows that several hundred of the largest corporations now earmark 34 per cent of their total donations to education, as compared with only 21 per cent in 1950. And as their gifts increase, corporations put more and more thought into how the money donated is spent. Full-time company staff members sometimes scrutinize educational needs. One result has been a greater emphasis on gifts to improve the overall quality of teaching. Says one corporate giver: "We feel it is more important to strengthen the institutions themselves, than it is to give scholarships to send students to universities with inadequate facilities."

MATERIALS

The properties and new applications of materials used in the mechanical industries

High-Strength Structural and Hot-Die Steel

A chromium-molybdenum-vanadium hot-work steel which was first produced for tool and die applications requiring strength at elevated temperatures is now finding use in making component parts for high-speed aircraft and metals. The steel produced by Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa., is an AISI type H-11 steel marketed under the name "Potomac A."

It has a nominal percentage composition of: carbon, 0.40; manganese, 0.30; silicon, 0.90; chromium, 5.00; molybdenum, 1.30; vanadium, 0.50; and the balance, iron. At temperatures up to 1000 degrees F. the steel has the highest strength of any presently in use for aircraft or missile components. A combination of good ductility along with the the highest yield strength to weight ratio between 400 and 1000 degrees F. of any commercial structural material makes this steel an ideal choice for high-speed aircraft and missiles.

These pure, porous alumina tubes, available under the trade name of "Triangle R," are recommended for use in platinum, molybdenum, and tungsten wound heating elements for melting and heat-treatment processes at high temperatures (up to 3540 degrees F.). They are a product of Morganite Inc., Refractories Division, 3300 48th Ave., Long Island City 1, N.Y.

Coating which Prevents Heat-Treatment Scale

A coating which prevents scale formation on metal during heat-treatment has been marketed by Navan Products, Inc., Los Angeles, Calif. The product, called "Skalix," is applied by spraying or dipping and adheres to the metal at furnace temperatures, forming an oxygen-tight seal. As the metal cools, the coating pops off by itself. A gallon of this material will cover approximately 1500 square feet of metal surface. Applications include use on stainless steel, nickel-chromium alloys, cobalt alloys, and many new superalloys.

Sprayable High-Strength Elastomeric Base Adhesive Developed

A high-strength, oil-resistant elastomeric base adhesive developed for automatic spray application in volume-production operations for bonding a wide variety of porous and nonporous materials has been made available by Adhesives, Coatings, and Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. Designated as "EC-1390," this adhesive produces bonds which have high softening points and resist plastic flow. Besides being used for automatic spray application, it may also be hand-sprayed or brushed.

The adhesive produces high-strength laminates with such materials as plastic, thin-gage aluminum and steel, porcelain-enameled steel, linoleum, leather, rubber, wood, and others. It has been used to bond aluminum facings to paper honeycomb cores in sandwich-panel construc-

tion, bond aluminum sheeting to tempered masonite, and bond insulation material to galvanized steel.

Wood-to-steel bonds have shear strengths in the range of 400 psi. Other combinations have similar shear strengths and after proper curing, peel strengths ranging from 30 to 50 pounds per inch of width.

Plastic Compounds Provide a Tough Resistance Coating for Surfaces

For protection against corrosion, erosion, abrasion, solvents, and chemical attack, the Farboil Co., Baltimore 30, Maryland, has made available coatings called "Farboil Epothanes." These coatings will protect walls, floors, equipment tanks, and pipe lines against chemicals, solvents, abrasion, and impact. The coatings are made expressly for the building, industrial, and marine industries.

Temperature Indicators in Stick, Pellet, and Liquid Form

A precision temperature indicator available in stick, pellet, and liquid form, designated by the name "Thermomelt," has been announced by Markal Co., 3052 West Carroll Ave., Chicago 12, Ill. This indicator is usable in a temperature range of 113 to 2000 degrees F. In use, a mark from the stick, a bit of liquid, or a pellet is placed on the surface. When the surface reaches the desired temperature the mark or the pellet quickly liquefies.

New Sharpness Attained in Discs and Belts for Grinding

A line of resin-bonded, aluminum-oxide coated abrasives with a sharpness and cutting life never before attained has been developed by Behr-Manning Co., a division of Norton Co., Troy, N. Y. Known as "Metallite Type 101," the abrasive is available on fiber discs and cloth belts. It cuts fast, keeps work cool, and keeps shedding to a minimum. The discs are available in a grit range from 150 through 24, and the belts, from 180 through 24.

Self-Fluxing Brazing Alloys for High-Temperature Service

An additional line of self-fluxing "Nicrobraz" brazing alloys for high-temperature service applications has been made available by Stainless Processing Division, Wall Colmonoy Corporation, 19345 John R St., Detroit 3, Mich. These alloys, designated "Nicrobraz Standard-W, 30-W, 50-W, 60-W, 130-W, 150-W, and LM-W," contain a vaporizing flux which permits brazing of difficult alloys (such as aluminum and titanium bearing metals) in hydrogen and argon atmospheres.

The vaporizing flux constitutents insure optimum wetting and flow by cleaning the base metal ahead of the alloy wetting range. The flux will attack no known base metal and leaves no residue. It has no deleterious effect on heat and corrosion resistance or any other property of the brazing alloy.

Hydraulic-Fluid-Line Tubing Available from Warehouse Stocks

Cold-drawn, welded hydraulic-fluid-line tubing has been made available from the warehouse stocks of Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill. This tubing has been approved by the JIC, meeting or exceeding the hydraulic standard specifications developed by this body. The tubing bends and flares easily and uniformly. Each length is hydrostatically tested. The tubing has been protected against corrosion by a coating of oil on both surfaces, and both ends are corked to keep out dirt and other foreign matter. It is available in sizes from 1/4 to 1 1/4 inches in diameter and in wall thicknesses from 13 through 20 gage.

Flat Stainless-Steel Spring Material with High Elasticity

A flat form of precipitation-hardening stainless-steel spring wire has been introduced by National-Standard Co., Niles, Mich. The wire, rolled from round 17-7 PH wire, has great dimensional stability, a modulus of elasticity of 29,500,000 in tension, and 11,000,000 in torsion.

This wire is an alloy of chromium (16.00 to 18.00 per cent); nickel (6.50 to 7.75 per cent); manganese (1.00 per cent max.); silicon (1.00 per cent max.); aluminum (0.75 to 1.50 per cent); carbon (0.09 per cent max.); phosphorous (0.04 per cent max.); and sulfur (0.03 per cent max.). It is furnished annealed, one-fourth hard, one-half hard, three-fourths hard, or full-hard in bright or copper finish in widths up to 0.300 inch and in a minimum thickness of 0.009 inch. Applications include hair-clip springs, electrical-timer springs, and sprinkler assembly clips.

Economical, Unfilled, Modified Epoxy Adhesive Announced

The availability of a 100 per cent solids, unfilled, modified epoxy adhesive called "Bondmaster M685" has been announced by Rubber & Asbestos Corporation, 225 Belleville Ave., Bloomfield, N. J. This two-part, room-temperature-curing formulation is a free-flowing liquid (approxi-

mately 3000 to 7000 centipoises) of intermediate strength and clear, pale amber color. At room temperature the bond assembly can be handled in six to eight hours and develops 85 per cent of maximum strength in fourteen to twenty-four hours. This formulation may be heat-cured in as little time as ten minutes at 250 degrees F. with one of the hardeners available.

Extreme-Temperature Dry Lubricant Now Available

"EverLube 811," a multiple-purpose dry lubricant, has been developed by EverLube Corporation, 6940 Farmdale Ave., North Hollywood, Calif. This material has proved effective in a temperature range from −300 degrees F. to +1000 degrees F. at bearing loads up to 50,000 psi. It is completely inorganic, nonflammable, nontoxic, and does not require extreme temperature cure. It is suitable for use in refrigeration applications.

Rust Solvent with a Unique Spreading Ability

A penetrating rust solvent that spreads fast and far has been announced by Keystone Lubricating Co., 3100 North 21st St., Philadelphia 32, Pa. Known as "KPO No. 1," this product has a wetting power which enables it to penetrate deeply and quickly into rust-frozen surfaces. The material also has the necessary film body to lubricate and protect parts being disengaged. Its low volatility provides long-lasting action. Rusted nuts and bolts can be separated, and flanges, couplings, pulleys, and wheels can easily be removed from shafts.

The retainers of these ball bearings are molded of "Plaskon Nylon." The use of this material, which is a product of Plastics and Coal Chemicals Division, Allied Chemical Corporation, 40 Rector St., New York 6, N. Y., facilitates assembly by requiring only a simple pressing operation to position the balls in the retainer.

Pink Quartz of Cubical Shape for Barrel Finishing

A pink quartz, called "Type Q Medium," is being marketed by Techline Division, Wheelabrator Corporation, 1147 Avenue V, Vicksburg, Mich. The material is processed into shapes predominantly cubical rather than random. This shape tends to reduce the problem of lodgement when intricately shaped parts are being finished. The material is fine-textured, and its smoothness of surface permits its use in burnishing, substituting for steel balls. It is available in a full range of sizes from 00 through 6.

Carburizing Steel for Jet Aircraft Engine Parts

Latrobe Steel Co., Latrobe, Pa., is producing a steel in its vacuum consumable-electrode melting furnace that is characterized by higher cleanliness and improved fatigue strength over conventionally known SAE 9310 steel. Called "Vac-Arc AGT (SAE 9310)" steel, it has a tensile strength ranging from 155,000 to 185,000 psi, a yield strength of 130,000 to 162,000 psi, and an elongation in 2 inches of 15 to 16 per cent. It has high hardenability, high core hardness, and high fatigue strength.

In the annealed condition it has a machinability of 40 per cent of B-1112 steel. This steel is available in a variety of billet, bar, and forging forms.

Phosphating Compound for Low-Temperature Application

Development of a phosphating compound that operates at a temperature as much as 75 degrees F. or lower than that required by conventional phosphating processes has been announced by Turco Products, Inc., 24600 South Main St., Wilmington, Calif. Called "Turcoat Low Temp," it provides a uniformly smooth coating of up to 200 milligrams psf (per square foot) in two minutes at 95 degrees F. Such a coating is used as a bond for paint. It may also be used as a base for corrosion prevention, in which case it is applied in amounts up to 1100 milligrams psf in ten to fifteen minutes at 95 degrees F. It may be applied by immersion or by means of a spray washer.

MACHINERY'S Reference Section

New Tables Simplify Helical-Spring "Arithmetic"

PART I

Spring index and wire diameter in 0.001-inch increments are the entering values for these unique tables which enable rapid and direct determination of coil dimensions and important design characteristics. Problems illustrating the use of the tables will be given in Part II, to be published in March MACHINERY

PETER F. ROSSMANN

HELICAL SPRINGS are essential to the operation of many devices, and as a result, have been the subject of considerable research. In addition, numerous charts and other design aids have been developed to help reduce and simplify the often laborious computations connected with spring selection. However useful these aids may be, they are for the most part limited to certain specific applications and do not show all coil dimensions.

A more general and direct approach to the simplification of helical-spring calculations is made possible by the accompanying tables. These tables are unusual in that the spring index (the ratio of the coil pitch diameter to the wire diameter) and the wire diameter in 0.001-inch increments are the entering values. Also tabulated are the pitch, inside, and outside coil diameters as well as the load and deflection characteristics needed for spring selection.

The tables will be of considerable assistance in selecting the proper wire diameter, appropriate coil diameters, and number of coils to best fit a designated space and obtain the desired deflection while yet being able to withstand the expected maximum deflection or load. Alternatively, they can be used to determine the maximum load and expected deflections if the spring size is already known. The data may be used directly for design purposes, or for verifying information obtained either by use of spring-design formulas or by use of special design charts.

Although the tables are computed for round steel wire with a torsional modulus of rigidity of 11,500,000 psi and a maximum torsional stress of 100,000 psi, conversion factors enable the data to be used for square wire and other metals. An auxiliary table to permit rapid interpolation of the tabular values for intermediate spring indexes will be presented in Part II along with the conversion factors and the solution of typical problems. Because the present trend is toward miniaturization, these tables are timely, since the size range begins at a pitch diameter of 0.003 inch and covers all but very heavy springs. The curvature correction (Wahl) factor has been applied to the tabular values.

February, 1960

Helical Spring Tables

WIRE	SPRING INDEX →	3	4	5	6	7	8	9	10	11	12
.001	O.D.= Outside Dia.	.004	.005	.006	.007	.008	.009	.010	.011	.012	.013
	P.D.= Pitch Dia.	.003	.004	.005	.006	.007	.008	.009	.010	.011	.012
	I.D.= Inside Dia.	.002	.003	.004	.005	.006	.007	.008	.009	.010	.011
	F_c = Def./coil/lb.	.01879826	.0445217	.0869565	.150261	.238609	.356174	.507130	.695652	.925913	1.20209
	F_m = Max.Def./coil	.0015561O	.0003113374	.0005211141	.000785194	.001103367	.001476664	.00236622	.00292287	.00292287	.00351432
	P_m = Max.Load	.00926479	.00699375	.00599312	.00522554	.00462545	.00414583	.00375474	.00343019	.00315674	.00292355
	R_c = Rate Factor	53.2407	22.4609	11.5000	6.65509	4.19096	2.80762	1.97186	1.43750	1.08002	.851887
.002	O.D.= Outside Dia.	.008	.010	.012	.014	.016	.018	.020	.022	.024	.026
	P.D.= Pitch Dia.	.006	.008	.010	.012	.014	.016	.018	.020	.022	.024
	I.D.= Inside Dia.	.004	.006	.008	.010	.012	.014	.016	.018	.020	.022
	F_c = Def./coil/lb.	.00939130	.0222609	.0434783	.0751304	.119304	.178087	.253565	.347826	.462957	.601043
	F_m = Max.Def./coil	.0003112220	.0006622748	.00104228	.001570390	.002202734	.002953279	.00380829	.00477243	.00584574	.00702824
	P_m = Max.Load	.03331392	.0279750	.0239725	.0209021	.01850017	.0165833	.0150190	.0137207	.0126270	.0116934
	R_c = Rate Factor	106.481	44.9219	23.0000	13.3102	8.39102	5.61523	3.94376	2.87500	2.16003	1.66377
.003	O.D.= Outside Dia.	.012	.015	.018	.021	.024	.027	.030	.033	.036	.039
	P.D.= Pitch Dia.	.009	.012	.015	.018	.021	.024	.027	.030	.033	.036
	I.D.= Inside Dia.	.006	.009	.012	.015	.018	.021	.024	.027	.030	.033
	F_c = Def./coil/lb.	.00626086	.0148406	.0289855	.0500869	.0795362	.118725	.169043	.231884	.308637	.400695
	F_m = Max.Def./coil	.0004668830	.0009934122	.00156342	.00235558	.00331100	.00442991	.00571843	.00715865	.00876861	.0105424
	P_m = Max.Load	.0745831	.0629438	.0539381	.0470298	.0416289	.0373125	.0337927	.0308717	.0284107	.0263102
	R_c = Rate Factor	159.722	67.3828	34.5000	19.9653	12.5729	8.42285	5.91564	4.31250	3.24005	2.49546
.004	O.D.= Outside Dia.	.016	.020	.024	.028	.032	.036	.040	.044	.048	.052
	P.D.= Pitch Dia.	.012	.016	.020	.024	.028	.032	.036	.040	.044	.048
	I.D.= Inside Dia.	.008	.012	.016	.020	.024	.028	.032	.036	.040	.044
	F_c = Def./coil/lb.	.00469565	.0111304	.0217391	.0376652	.0596522	.0890435	.126783	.173913	.231478	.300522
	F_m = Max.Def./coil	.0003502440	.00124550	.00209456	.00314077	.00441467	.00590655	.00761658	.00954486	.0116915	.0140565
	P_m = Max.Load	.132557	.111900	.0958899	.0836088	.0740069	.0663333	.0600759	.0548850	.0508079	.0467736
	R_c = Rate Factor	212.963	89.8438	46.0000	26.6204	16.7638	11.2305	7.88752	5.75000	4.38006	3.32755
.005	O.D.= Outside Dia.	.020	.025	.030	.035	.040	.045	.050	.055	.060	.065
	P.D.= Pitch Dia.	.015	.020	.025	.030	.035	.040	.045	.050	.055	.060
	I.D.= Inside Dia.	.010	.015	.020	.025	.030	.035	.040	.045	.050	.055
	F_c = Def./coil/lb.	.00375652	.00890435	.0173913	.0300522	.0477217	.0712548	.101426	.139130	.185183	.240417
	F_m = Max.Def./coil	.0007778050	.00155687	.00260570	.00392597	.00551834	.00738319	.00952072	.0119311	.0146144	.0175706
	P_m = Max.Load	.207120	.174844	.149828	.130658	.115636	.103646	.0938686	.0867546	.0789186	.0730836
	R_c = Rate Factor	266.804	112.305	57.5000	33.2755	20.9548	14.0381	9.85940	7.18750	5.40009	4.15943
.006	O.D.= Outside Dia.	.024	.030	.036	.042	.048	.054	.060	.066	.072	.078
	P.D.= Pitch Dia.	.018	.024	.030	.036	.042	.048	.054	.060	.066	.072
	I.D.= Inside Dia.	.012	.018	.024	.030	.036	.042	.048	.054	.060	.066
	F_c = Def./coil/lb.	.00313044	.007482030	.0144928	.0250435	.0397682	.0593624	.0845219	.115942	.154319	.200346
	F_m = Max.Def./coil	.0009333660	.00186824	.00312684	.00471116	.00662201	.00885982	.0114249	.0143173	.0175372	.0210847
	P_m = Max.Load	.298252	.251775	.215752	.188119	.166516	.149250	.135171	.123487	.113643	.105241
	R_c = Rate Factor	319.444	134.766	69.0000	39.9306	25.1458	16.8457	11.8313	8.62500	6.48009	4.99132
.007	O.D.= Outside Dia.	.028	.035	.042	.049	.056	.063	.070	.077	.084	.091
	P.D.= Pitch Dia.	.021	.028	.035	.042	.049	.056	.063	.070	.077	.084
	I.D.= Inside Dia.	.014	.021	.028	.035	.042	.049	.056	.063	.070	.077
	F_c = Def./coil/lb.	.00268323	.006360624	.0124223	.0214658	.0340869	.0508819	.0724471	.0993788	.132273	.171727
	F_m = Max.Def./coil	.0010892?	.00217962	.00364799	.00549636	.00772568	.0103565	.0133290	.0167035	.0204601	.0245989
	P_m = Max.Load	.405955	.342694	.293663	.256051	.226646	.203146	.183982	.168079	.154681	.143244
	R_c = Rate Factor	372.685	157.227	80.5000	46.5856	29.5367	19.6533	13.8032	10.0625	7.56011	5.82321
.008	O.D.= Outside Dia.	.032	.040	.048	.056	.064	.072	.080	.088	.096	.104
	P.D.= Pitch Dia.	.024	.032	.040	.048	.056	.064	.072	.080	.088	.096
	I.D.= Inside Dia.	.016	.024	.032	.040	.048	.056	.064	.072	.080	.088
	F_c = Def./coil/lb.	.00254783	.0055622	.0108696	.0187826	.0298261	.0446217	.0635913	.0869565	.115739	.150261
	F_m = Max.Def./coil	.00124488	.00249099	.00416913	.00628155	.00882934	.0118131	.0152332	.0190897	.0233850	.0281130
	P_m = Max.Load	.550227	.447600	.385560	.334434	.296028	.265533	.240303	.219532	.202032	.187094
	R_c = Rate Factor	425.926	179.888	92.0000	53.2407	33.5277	22.4609	15.7750	11.5000	8.64012	6.65509
.009	O.D.= Outside Dia.	.036	.045	.054	.063	.072	.081	.090	.099	.108	.117
	P.D.= Pitch Dia.	.027	.036	.045	.054	.063	.072	.081	.090	.099	.108
	I.D.= Inside Dia.	.018	.027	.036	.045	.054	.063	.072	.081	.090	.099
	F_c = Def./coil/lb.	.00208695	.00494685	.00961183	.0166956	.0265121	.0397748	.0565478	.0772946	.102879	.133565
	F_m = Max.Def./coil	.00140049	.00280257	.00468027	.00706874	.00993301	.0133897	.0171375	.0214759	.0263058	.0316271
	P_m = Max.Load	.671068	.565494	.485445	.423268	.374650	.334812	.304134	.277845	.255696	.236791
	R_c = Rate Factor	479.167	202.148	103.500	59.8958	37.7187	25.2686	17.7469	12.9375	9.72014	7.48698
.010	O.D.= Outside Dia.	.040	.050	.060	.070	.080	.090	.100	.110	.120	.130
	P.D.= Pitch Dia.	.030	.040	.050	.060	.070	.080	.090	.100	.110	.120
	I.D.= Inside Dia.	.020	.030	.040	.050	.060	.070	.080	.090	.100	.110
	F_c = Def./coil/lb.	.00187826	.00445217	.00869565	.0150261	.0238609	.0356174	.0507130	.0695652	.0925913	.120209
	F_m = Max.Def./coil	.0015561O	.0031137?	.0052114?	.0078519?	.0110367	.0147664	.0190414	.0238622	.0292287	.0351432
	P_m = Max.Load	.828479	.699375	.599312	.522554	.462543	.414583	.375474	.343019	.315674	.292355
	R_c = Rate Factor	532.407	224.609	115.000	66.5509	41.9096	28.0762	19.7186	14.3750	10.8002	8.51887

WIRE	SPRING INDEX ⟶	3	4	5	6	7	8	9	10	11	12
.011	O.D.- Outside Dia.	.044	.055	.066	.077	.088	.099	.110	.121	.132	.143
	P.D.- Pitch Dia.	.033	.044	.055	.066	.077	.088	.099	.110	.121	.132
	I.D.- Inside Dia.	.022	.033	.044	.055	.066	.077	.088	.099	.110	.121
	F_1 - Def./coil/lb.	.00170751	.00404743	.00790514	.0136601	.0216917	.0323794	.0461028	.0632411	.0841739	.109281
	F_2 - Max.Def./coil	.00171171	.00342511	.00573255	.00863713	.0121403	.0162430	.0209456	.0262484	.0321516	.0386553
	F_w - Max.Load	1.00246	.846244	.725167	.632290	.559677	.501646	.454324	.415052	.381966	.353725
	R_1 - Rate Factor	585.648	247.070	126.500	73.2060	46.1006	30.8838	21.6907	15.8125	11.8802	9.15075
.012	O.D.- Outside Dia.	.048	.060	.072	.084	.096	.108	.120	.132	.144	.156
	P.D.- Pitch Dia.	.036	.048	.060	.072	.084	.096	.108	.120	.132	.144
	I.D.- Inside Dia.	.024	.036	.048	.060	.072	.084	.096	.108	.120	.132
	F_1 - Def./coil/lb.	.00156522	.00371014	.00724637	.0125217	.0198841	.0296811	.0422609	.0579710	.0771594	.100174
	F_2 - Max.Def./coil	.00186732	.00373649	.00625369	.00942252	.0132440	.0177196	.0228497	.0286346	.0350745	.0421695
	F_w - Max.Load	1.19301	1.00710	.863009	.752477	.666082	.597000	.540683	.493947	.454571	.420963
	R_1 - Rate Factor	638.889	269.531	138.000	79.8611	50.2915	33.6914	23.6826	17.2500	12.9602	9.98264
.013	O.D.- Outside Dia.	.052	.065	.078	.091	.104	.117	.130	.143	.156	.169
	P.D.- Pitch Dia.	.039	.052	.065	.078	.091	.104	.117	.130	.143	.156
	I.D.- Inside Dia.	.026	.039	.052	.065	.078	.091	.104	.117	.130	.143
	F_1 - Def./coil/lb.	.00144482	.00342475	.00668897	.0115585	.0183545	.0273980	.0390100	.0535117	.0712241	.0924683
	F_2 - Max.Def./coil	.00202293	.00404786	.00677483	.0102075	.0143477	.0191963	.0247539	.0310208	.0379973	.0456836
	F_w - Max.Load	1.40013	1.18194	1.01284	.883116	.781698	.700646	.634551	.579701	.533490	.494046
	R_1 - Rate Factor	692.130	291.992	149.500	86.5162	54.4825	36.4990	25.6344	18.6875	14.0402	10.8145
.014	O.D.- Outside Dia.	.056	.070	.084	.098	.112	.126	.140	.154	.168	.182
	P.D.- Pitch Dia.	.042	.056	.070	.084	.098	.112	.126	.140	.154	.168
	I.D.- Inside Dia.	.028	.042	.056	.070	.084	.098	.112	.126	.140	.154
	F_1 - Def./coil/lb.	.00134162	.00318013	.00621118	.0107329	.0170435	.0254410	.0362236	.0496895	.0661367	.0858634
	F_2 - Max.Def./coil	.00217854	.00435923	.00729597	.0109927	.0154514	.0206729	.0266580	.0334070	.0409202	.0491977
	F_w - Max.Load	1.62382	1.37078	1.17465	1.02421	.906884	.812583	.735929	.672316	.618722	.572977
	R_1 - Rate Factor	745.370	314.453	161.000	93.1713	58.6735	39.3068	27.6063	20.1250	15.1202	11.6464
.015	O.D.- Outside Dia.	.060	.075	.090	.105	.120	.135	.150	.165	.180	.195
	P.D.- Pitch Dia.	.045	.060	.075	.090	.105	.120	.135	.150	.165	.180
	I.D.- Inside Dia.	.030	.045	.060	.075	.090	.105	.120	.135	.150	.165
	F_1 - Def./coil/lb.	.00125217	.00296812	.00579710	.0100174	.0159073	.0237449	.0338087	.0463766	.0617276	.0801392
	F_2 - Max.Def./coil	.00233415	.00467061	.00781711	.0117779	.0165550	.0221496	.0285622	.0357932	.0438431	.0527118
	F_w - Max.Load	1.86408	1.57359	1.34845	1.17575	1.04072	.932812	.844817	.771792	.710268	.657764
	R_1 - Rate Factor	798.611	336.914	172.500	99.8264	62.8644	42.1143	29.5782	21.5625	16.2002	12.4763
.016	O.D.- Outside Dia.	.064	.080	.096	.112	.128	.144	.160	.176	.192	.208
	P.D.- Pitch Dia.	.048	.064	.080	.096	.112	.128	.144	.160	.176	.192
	I.D.- Inside Dia.	.032	.048	.064	.080	.096	.112	.128	.144	.160	.176
	F_1 - Def./coil/lb.	.00117391	.00278261	.00543478	.00939130	.0149130	.0222609	.0316957	.0434783	.0578696	.0751304
	F_2 - Max.Def./coil	.00248976	.00498196	.00833825	.0125631	.0176587	.0236262	.0304663	.0381798	.0467659	.0562260
	F_w - Max.Load	2.12091	1.79040	1.53424	1.33774	1.18411	1.06133	.961214	.878128	.808127	.748378
	R_1 - Rate Factor	851.852	359.375	184.000	106.401	67.0554	44.9219	31.5501	23.0000	17.2802	13.3102
.017	O.D.- Outside Dia.	.068	.085	.102	.119	.136	.153	.170	.187	.204	.221
	P.D.- Pitch Dia.	.051	.068	.085	.102	.119	.136	.153	.170	.187	.204
	I.D.- Inside Dia.	.034	.051	.068	.085	.102	.119	.136	.153	.170	.187
	F_1 - Def./coil/lb.	.00110486	.00261692	.00511509	.00881887	.0140356	.0209514	.0298312	.0409207	.0544654	.0707110
	F_2 - Max.Def./coil	.00264557	.00529356	.00885939	.0133485	.0187624	.0251028	.0323704	.0405657	.0496888	.0597401
	F_w - Max.Load	2.39430	2.02119	1.73201	1.51018	1.33675	1.19815	1.08512	.991324	.912299	.844848
	R_1 - Rate Factor	905.093	381.836	195.500	113.137	71.2464	47.7895	33.5219	24.4375	18.3603	14.1421
.018	O.D.- Outside Dia.	.072	.090	.108	.126	.144	.162	.180	.198	.216	.234
	P.D.- Pitch Dia.	.054	.072	.090	.108	.126	.144	.162	.180	.198	.216
	I.D.- Inside Dia.	.036	.054	.072	.090	.108	.126	.144	.162	.180	.198
	F_1 - Def./coil/lb.	.00104348	.00247343	.00483092	.00834783	.0132560	.0197878	.0281739	.0386474	.0514397	.0667827
	F_2 - Max.Def./coil	.00280098	.00560473	.00938053	.0141535	.0198660	.0265795	.0342746	.0429819	.0526117	.0632542
	F_w - Max.Load	2.68427	2.26898	1.94177	1.69307	1.49864	1.34325	1.21654	1.11138	1.02279	.947166
	R_1 - Rate Factor	958.333	404.297	207.000	119.792	75.4375	50.5371	35.4938	25.8750	19.4403	14.9760
.019	O.D.- Outside Dia.	.076	.095	.114	.133	.152	.171	.190	.209	.228	.247
	P.D.- Pitch Dia.	.057	.076	.095	.114	.133	.152	.171	.190	.209	.228
	I.D.- Inside Dia.	.038	.057	.076	.095	.114	.133	.152	.171	.190	.209
	F_1 - Def./coil/lb.	.000988559	.00234325	.00457666	.00790847	.0125584	.0187460	.0266911	.0366133	.0487323	.0632678
	F_2 - Max.Def./coil	.00295659	.00591610	.00990167	.0149187	.0209697	.0280861	.0361787	.0453381	.0555346	.0667683
	F_w - Max.Load	2.99081	2.62474	2.16352	1.88642	1.66978	1.49668	1.35546	1.23830	1.13958	1.05533
	R_1 - Rate Factor	1011.87	426.758	218.500	126.447	79.6283	53.3447	37.4657	27.3125	20.5203	15.8058
.020	O.D.- Outside Dia.	.080	.100	.120	.140	.160	.180	.200	.220	.240	.260
	P.D.- Pitch Dia.	.060	.080	.100	.120	.140	.160	.180	.200	.220	.240
	I.D.- Inside Dia.	.040	.060	.080	.100	.120	.140	.160	.180	.200	.220
	F_1 - Def./coil/lb.	.000939130	.00222609	.00434783	.00751304	.0119304	.0178087	.0253565	.0347826	.0462987	.0601043
	F_2 - Max.Def./coil	.00311220	.00622748	.0104228	.0157039	.0220734	.0295327	.0380829	.0477243	.0584574	.0703824
	F_w - Max.Load	3.31392	2.79750	2.39725	2.09021	1.85017	1.65833	1.50190	1.37207	1.26270	1.16934
	R_1 - Rate Factor	1064.81	449.219	230.000	133.102	83.8192	56.1523	39.4376	28.7500	21.6003	16.6377

Helical Spring Tables

WIRE	SPRING INDEX ——→	3	4	5	6	7	8	9	10	11	12
.021	O.D.- Outside Dia.	.084	.105	.126	.147	.168	.189	.210	.231	.252	.273
	P.D.- Pitch Dia.	.063	.084	.105	.126	.147	.168	.189	.210	.231	.252
	I.D.- Inside Dia.	.042	.063	.084	.105	.126	.147	.168	.189	.210	.231
	P_1 - Def./coil/lb.	.0008894409	.00212008	.00414078	.00715527	.0113623	.0169606	.0241490	.0331263	.0440911	.0572422
	P_2 - Max.Def./coil	.00326781	.00653865	.0109440	.0164891	.0231770	.0310094	.0399870	.0501105	.0613803	.0737966
	P_3 - Max.Load	3.65359	3.08424	2.64297	2.30446	2.03982	1.82831	1.65584	1.51271	1.39212	1.28920
	R_1 - Rate Factor	1118.06	471.680	241.500	139.757	88.0102	58.9600	41.4095	30.1875	22.6803	17.4696
.022	O.D.- Outside Dia.	.088	.110	.132	.154	.176	.198	.220	.242	.264	.286
	P.D.- Pitch Dia.	.066	.088	.110	.132	.154	.176	.198	.220	.242	.264
	I.D.- Inside Dia.	.044	.066	.088	.110	.132	.154	.176	.198	.220	.242
	P_1 - Def./coil/lb.	.0009353754	.00202371	.00395257	.00683003	.0108458	.0161897	.0230514	.0316205	.0420969	.0546403
	P_2 - Max.Def./coil	.00342342	.00685023	.0114651	.0172743	.0242807	.0324860	.0418912	.0524968	.0644032	.0773107
	P_3 - Max.Load	4.00984	3.39498	2.90067	2.52916	2.23071	2.00658	1.81730	1.66021	1.52786	1.41490
	R_1 - Rate Factor	1171.30	494.141	255.000	146.412	92.2012	61.7676	43.3813	31.6250	23.7603	18.3015
.023	O.D.- Outside Dia.	.092	.115	.138	.161	.184	.207	.230	.253	.276	.299
	P.D.- Pitch Dia.	.069	.092	.115	.138	.161	.184	.207	.230	.253	.276
	I.D.- Inside Dia.	.046	.069	.092	.115	.138	.161	.184	.207	.230	.253
	P_1 - Def./coil/lb.	.0009816636	.00193573	.00378072	.00653309	.0103743	.0154858	.0220492	.0302458	.0402571	.0522647
	P_2 - Max.Def./coil	.00357903	.00716160	.0119862	.0180595	.0253844	.0339627	.0437853	.0548850	.0672260	.0808248
	P_3 - Max.Load	4.58265	3.69969	3.17036	2.76431	2.44685	2.19314	1.98626	1.81457	1.66992	1.54645
	R_1 - Rate Factor	1224.54	516.602	264.500	153.087	96.3921	64.5752	45.3532	33.0625	24.8403	19.1334
.024	O.D.- Outside Dia.	.096	.120	.144	.168	.192	.216	.240	.264	.288	.312
	P.D.- Pitch Dia.	.072	.096	.120	.144	.168	.192	.216	.240	.264	.288
	I.D.- Inside Dia.	.048	.072	.096	.120	.144	.168	.192	.216	.240	.264
	P_1 - Def./coil/lb.	.0007782609	.00185507	.00362319	.00626087	.00994204	.0148406	.0211305	.0289855	.0385797	.0502870
	P_2 - Max.Def./coil	.00373464	.00747297	.0125074	.0188446	.0264880	.0354393	.0456995	.0572692	.0701489	.0843389
	P_3 - Max.Load	4.77204	4.02840	3.45204	3.00991	2.66425	2.38800	2.16273	1.97579	1.81859	1.68386
	R_1 - Rate Factor	1277.73	539.063	276.000	159.722	100.583	67.3828	47.3261	34.5000	25.9204	19.9853
.025	O.D.- Outside Dia.	.100	.125	.150	.175	.200	.225	.250	.275	.300	.325
	P.D.- Pitch Dia.	.075	.100	.125	.150	.175	.200	.225	.250	.275	.300
	I.D.- Inside Dia.	.050	.075	.100	.125	.150	.175	.200	.225	.250	.275
	P_1 - Def./coil/lb.	.0007751304	.00178087	.00347826	.00601043	.00964435	.0144470	.0202852	.0278261	.0370365	.0480855
	P_2 - Max.Def./coil	.00389025	.00778435	.0130285	.0196898	.0275917	.0369159	.0476036	.0596554	.0730718	.0878551
	P_3 - Max.Load	5.17799	4.37109	3.74570	3.26596	2.89089	2.59114	2.34671	2.14387	1.97297	1.82709
	R_1 - Rate Factor	1331.02	561.523	287.500	166.377	104.774	70.1904	49.2970	35.9375	27.0014	20.7972
.026	O.D.- Outside Dia.	.104	.130	.156	.182	.208	.234	.260	.286	.312	.338
	P.D.- Pitch Dia.	.078	.104	.130	.156	.182	.208	.234	.260	.286	.312
	I.D.- Inside Dia.	.052	.078	.104	.130	.156	.182	.208	.234	.260	.286
	P_1 - Def./coil/lb.	.0007722407	.00171237	.00334448	.00577928	.00917725	.0136990	.0195050	.0267558	.0356120	.0462341
	P_2 - Max.Def./coil	.00404586	.00809572	.0135497	.0204150	.0286954	.0386926	.0503077	.0638211	.0759947	.0913578
	P_3 - Max.Load	5.60052	4.72778	4.05135	3.53246	3.12679	2.80258	2.53821	2.31881	2.13396	1.97619
	R_1 - Rate Factor	1384.26	583.984	299.000	173.032	108.965	72.9980	51.2889	37.3750	28.0804	21.6291
.027	O.D.- Outside Dia.	.108	.135	.162	.189	.216	.243	.270	.297	.324	.351
	P.D.- Pitch Dia.	.081	.108	.135	.162	.189	.216	.243	.270	.297	.324
	I.D.- Inside Dia.	.054	.081	.108	.135	.162	.189	.216	.243	.270	.297
	P_1 - Def./coil/lb.	.0006695651	.00164895	.00322061	.00556521	.00883735	.0131916	.0187826	.0257649	.0342930	.0445217
	P_2 - Max.Def./coil	.00420147	.00840710	.0140708	.0212002	.0297990	.0418592	.0514119	.0644278	.0789175	.0948813
	P_3 - Max.Load	6.03961	5.09844	4.36898	3.80942	3.37194	3.02231	2.73721	2.50061	2.30127	2.13112
	R_1 - Rate Factor	1437.50	606.445	310.500	179.687	113.156	75.8057	53.2407	38.8125	29.1604	22.4609
.028	O.D.- Outside Dia.	.112	.140	.168	.196	.224	.252	.280	.308	.336	.364
	P.D.- Pitch Dia.	.084	.112	.140	.168	.196	.224	.252	.280	.308	.336
	I.D.- Inside Dia.	.056	.084	.112	.140	.168	.196	.224	.252	.280	.308
	P_1 - Def./coil/lb.	.0006670808	.00159006	.00310559	.00536646	.00858174	.0127305	.0181118	.0248447	.0330683	.0429347
	P_2 - Max.Def./coil	.00435708	.00871847	.0145919	.0219854	.0330927	.0473458	.0533160	.0668141	.0818404	.0983954
	P_3 - Max.Load	6.49528	5.48310	4.69860	4.09682	3.62634	3.25033	2.94372	2.68927	2.47489	2.29191
	R_1 - Rate Factor	1490.74	628.906	322.000	186.343	117.347	78.6133	55.2126	40.2500	30.2404	23.2928
.029	O.D.- Outside Dia.	.116	.145	.174	.203	.232	.261	.290	.319	.348	.377
	P.D.- Pitch Dia.	.087	.116	.145	.174	.203	.232	.261	.290	.319	.348
	I.D.- Inside Dia.	.058	.087	.116	.145	.174	.203	.232	.261	.290	.319
	P_1 - Def./coil/lb.	.0006476777	.00153523	.00299850	.00518142	.00822790	.0122819	.0174873	.0239880	.0319281	.0414513
	P_2 - Max.Def./coil	.00451869	.00902984	.0151151	.0227706	.0342064	.0482225	.0552202	.0692003	.0847635	.101910
	P_3 - Max.Load	6.98751	5.88174	5.04021	4.39468	3.89999	3.49664	3.15774	2.88479	2.65488	2.45854
	R_1 - Rate Factor	1543.98	651.367	333.500	192.998	121.638	81.4809	57.1845	41.6875	31.3304	24.1247
.030	O.D.- Outside Dia.	.120	.150	.180	.210	.240	.270	.300	.330	.360	.390
	P.D.- Pitch Dia.	.090	.120	.150	.180	.210	.240	.270	.300	.330	.360
	I.D.- Inside Dia.	.060	.090	.120	.150	.180	.210	.240	.270	.300	.330
	P_1 - Def./coil/lb.	.0006626066	.00148406	.00289855	.00500869	.00795362	.0118785	.0169043	.0231884	.0308537	.0400695
	P_2 - Max.Def./coil	.00466830	.00934122	.0156542	.0235558	.0331100	.0442991	.0571843	.0715865	.0878861	.105424
	P_3 - Max.Load	7.45631	6.29438	5.39581	4.70298	4.16289	3.73125	3.37927	3.08717	2.84107	2.63102
	R_1 - Rate Factor	1597.22	673.828	345.000	199.653	125.739	84.2285	59.1564	43.1250	32.4005	24.9566

WIRE	SPRING INDEX ——→	3	4	5	6	7	8	9	10	11	12
.031	O.D.- Outside Dia.	.124	.155	.186	.217	.248	.279	.310	.341	.372	.403
	P.D.- Pitch Dia.	.093	.124	.155	.186	.217	.248	.279	.310	.341	.372
	I.D.- Inside Dia.	.062	.093	.124	.155	.186	.217	.248	.279	.310	.341
	F_1 - Def./coil/lb.	.000605891	.00143619	.00280505	.00484713	.00769706	.0114895	.0163591	.0224404	.0298682	.0387770
	F_2 - Max.Def./coil	.00482391	.00965259	.0161554	.0243410	.0342137	.0457757	.0590285	.0739727	.0906090	.108936
	F_M - Max.Load	7.96168	6.72099	5.75939	5.02174	4.44504	3.98414	3.60831	3.29641	3.03363	2.80934
	R_1 - Rate Factor	1650.46	696.289	356.500	206.308	129.920	87.0361	61.1283	44.5625	33.4805	25.7885
.032	O.D.- Outside Dia.	.128	.160	.192	.224	.256	.288	.320	.352	.384	.416
	P.D.- Pitch Dia.	.096	.128	.160	.192	.224	.256	.288	.320	.352	.384
	I.D.- Inside Dia.	.064	.096	.128	.160	.192	.224	.256	.288	.320	.352
	F_1 - Def./coil/lb.	.000586957	.00139130	.00271739	.00469565	.00745652	.0111304	.0158478	.0217391	.0289348	.0375652
	F_2 - Max.Def./coil	.00497952	.00996397	.0166765	.0251262	.0353174	.0472524	.0609326	.0763589	.0935319	.112452
	F_M - Max.Load	8.48363	7.16160	6.13695	5.35095	4.73644	4.24533	3.84486	3.51251	3.23251	2.99351
	R_1 - Rate Factor	1703.70	718.750	368.000	212.963	134.111	89.8438	63.1001	46.0000	34.5605	26.6204
.033	O.D.- Outside Dia.	.132	.165	.198	.231	.264	.297	.330	.363	.396	.429
	P.D.- Pitch Dia.	.099	.132	.165	.198	.231	.264	.297	.330	.363	.396
	I.D.- Inside Dia.	.066	.099	.132	.165	.198	.231	.264	.297	.330	.363
	F_1 - Def./coil/lb.	.000569169	.00134914	.00263504	.00455336	.00723056	.0107931	.0153676	.0210803	.0280579	.0364268
	F_2 - Max.Def./coil	.00513513	.0102753	.0171976	.0259114	.0364210	.0487290	.0628368	.0787451	.0964548	.115966
	P_M - Max.Load	9.02214	7.61619	6.52651	5.69061	5.03709	4.51481	4.08891	3.73547	3.43770	3.18353
	R_1 - Rate Factor	1756.94	741.211	379.500	219.618	138.302	92.6514	65.0720	47.4375	35.6405	27.4523
.034	O.D.- Outside Dia.	.136	.170	.204	.238	.272	.306	.340	.374	.408	.442
	P.D.- Pitch Dia.	.102	.136	.170	.204	.238	.272	.306	.340	.374	.408
	I.D.- Inside Dia.	.068	.102	.136	.170	.204	.238	.272	.306	.340	.374
	F_1 - Def./coil/lb.	.000552430	.00130946	.00255755	.00441944	.00701791	.0104757	.0149156	.0204604	.0272328	.0353555
	F_2 - Max.Def./coil	.00529074	.0105867	.0177188	.0266966	.0375247	.0502057	.0647409	.0811313	.0993776	.119480
	P_M - Max.Load	9.57722	8.08478	6.92804	6.04072	5.34700	4.79258	4.34048	3.96529	3.64920	3.37959
	R_1 - Rate Factor	1810.19	763.672	391.00	226.273	142.493	95.4590	67.0439	48.8750	36.7205	28.2841
.035	O.D.- Outside Dia.	.140	.175	.210	.245	.280	.315	.350	.385	.420	.455
	P.D.- Pitch Dia.	.105	.140	.175	.210	.245	.280	.315	.350	.385	.420
	I.D.- Inside Dia.	.070	.105	.140	.175	.210	.245	.280	.315	.350	.385
	F_1 - Def./coil/lb.	.000536645	.00127205	.00248447	.00429316	.00681738	.0101764	.0144894	.0198758	.0264546	.0343453
	F_2 - Max. Def./coil	.00544635	.0108981	.0182399	.0274818	.0386284	.0516823	.0666450	.0835176	.102300	.122994
	P_M - Max.Load	10.1489	8.56734	7.34157	6.40128	5.66615	5.07864	4.59956	4.20198	3.86701	3.58111
	R_1 - Rate Factor	1863.43	786.133	402.500	232.928	146.684	98.2665	69.0158	50.3125	37.8005	29.1160
.036	O.D.- Outside Dia.	.144	.180	.216	.252	.288	.324	.360	.396	.432	.468
	P.D.- Pitch Dia.	.108	.144	.180	.216	.252	.288	.324	.360	.396	.432
	I.D.- Inside Dia.	.072	.108	.144	.180	.216	.252	.288	.324	.360	.396
	F_1 - Def./coil/lb.	.000521740	.00123672	.00241546	.00417392	.00662802	.00989373	.0140870	.0193237	.0257198	.0333913
	F_2 - Max.Def./coil	.00560196	.0112095	.0187611	.0282670	.0397320	.0531589	.0685492	.0859038	.105223	.126508
	P_M - Max.Load	10.7371	9.06390	7.76708	6.77230	5.99456	5.37300	4.86615	4.44552	4.09114	3.78866
	R_1 - Rate Factor	1916.67	808.594	414.000	239.583	150.875	101.074	70.9877	51.7500	38.8805	29.9479
.037	O.D.- Outside Dia.	.148	.185	.222	.259	.296	.333	.370	.407	.444	.481
	P.D.- Pitch Dia.	.111	.148	.185	.222	.259	.296	.333	.370	.407	.444
	I.D.- Inside Dia.	.074	.111	.148	.185	.222	.259	.296	.333	.370	.407
	F_1 - Def./coil/lb.	.000507638	.00120329	.00235017	.00406110	.00644888	.00962631	.0137062	.0188014	.0250247	.0324888
	F_2 - Max.Def./coil	.00575757	.0115208	.0192822	.0290522	.0408357	.0546356	.0704533	.0882900	.108146	.130023
	P_M - Max.Load	11.3419	9.37444	8.20458	7.15376	6.33221	5.67564	5.14024	4.69592	4.32158	4.00207
	R_1 - Rate Factor	1969.91	831.055	425.500	246.238	155.066	103.882	72.9595	53.1875	39.9606	30.7798
.038	O.D.- Outside Dia.	.152	.190	.228	.266	.304	.342	.380	.418	.456	.494
	P.D.- Pitch Dia.	.114	.152	.190	.228	.266	.304	.342	.380	.418	.456
	I.D.- Inside Dia.	.076	.114	.152	.190	.228	.266	.304	.342	.380	.418
	F_1 - Def./coil/lb.	.000494279	.00117163	.00228833	.00395423	.00627918	.00937300	.0133455	.0183066	.0243661	.0316339
	F_2 - Max.Def./coil	.00591318	.0118322	.0198033	.0298374	.0419394	.0561122	.0723575	.0906762	.111069	.133537
	P_M - Max.Load	11.9632	10.0990	8.85406	7.54567	6.67912	5.98653	5.42185	4.95319	4.55834	4.22132
	R_1 - Rate Factor	2023.15	853.516	437.000	252.894	159.257	106.689	74.9314	54.6250	41.0406	31.6117
.039	O.D.- Outside Dia.	.156	.195	.234	.273	.312	.351	.390	.429	.468	.507
	P.D.- Pitch Dia.	.117	.156	.195	.234	.273	.312	.351	.390	.429	.468
	I.D.- Inside Dia.	.078	.117	.156	.195	.234	.273	.312	.351	.390	.429
	F_1 - Def./coil/lb.	.000481605	.00114158	.00222965	.00385284	.00611817	.00913266	.0130033	.0178372	.0237413	.0308227
	F_2 - Max.Def./coil	.00606879	.0121436	.0203245	.0306226	.0430431	.0575888	.0742616	.0930624	.113992	.137051
	P_M - Max.Load	12.6012	10.6375	9.11553	7.94804	7.03528	6.30581	5.71096	5.21731	4.80141	4.44642
	R_1 - Rate Factor	2076.39	875.977	448.500	259.549	163.448	109.497	76.9033	56.0625	42.1206	32.4436
.040	O.D.- Outside Dia.	.160	.200	.240	.280	.320	.360	.400	.440	.480	.520
	P.D.- Pitch Dia.	.120	.160	.200	.240	.280	.320	.360	.400	.440	.480
	I.D.- Inside Dia.	.080	.120	.160	.200	.240	.280	.320	.360	.400	.440
	F_1 - Def./coil/lb.	.000469565	.00111304	.00217391	.00375652	.00596522	.00890435	.0126783	.0173913	.0231478	.0300522
	F_2 - Max.Def./coil	.00622440	.0124550	.0208456	.0314077	.0441467	.0590655	.0761658	.0954486	.116915	.140565
	P_M - Max.Load	13.2557	11.1900	9.58899	8.36086	7.40069	6.63333	6.00759	5.48830	5.05079	4.67736
	R_1 - Rate Factor	2129.63	898.438	460.000	266.204	167.638	112.305	78.8752	57.5000	43.2006	33.2755

Helical Spring Tables

WIRE	SPRING INDEX ⟶	3	4	5	6	7	8	9	10	11	12
.041	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.164 .123 .082 .000458112 .00638001 13.9267 2182.87	.205 .164 .123 .00108589 .0127663 11.7565 920.898	.246 .205 .164 .00212099 .0213668 10.0744 471.500	.287 .246 .205 .00366489 .0321929 8.78413 272.859	.328 .287 .246 .00581971 .0458504 7.77535 171.829	.369 .328 .287 .00868715 .0685421 6.96914 115.112	.410 .369 .328 .0123690 .0780699 6.31172 80.8471	.451 .410 .369 .0169671 .0978349 5.76614 58.9375	.492 .451 .410 .0225838 .119838 5.30649 44.2806	.533 .492 .451 .0293191 .144079 4.91415 34.1073
.042	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.168 .126 .084 .000447205 .00653562 14.6144 2236.11	.210 .168 .126 .00106004 .0130777 12.3370 943.359	.252 .210 .168 .00207039 .0218879 10.5719 483.000	.294 .252 .210 .00357764 .0329781 9.21785 279.514	.336 .294 .252 .00568115 .0463541 8.15926 176.020	.378 .336 .294 .00948032 .0820188 7.31325 117.920	.420 .378 .336 .0120745 .0799740 6.62336 82.8158	.462 .420 .378 .0165631 .100221 6.05085 60.3750	.504 .462 .420 .0220455 .122761 5.56850 45.3606	.546 .504 .462 .0286211 .147593 5.15679 34.9358
.043	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.172 .129 .086 .000436805 .00669123 15.3186 2289.35	.215 .172 .129 .00103539 .0133891 12.9314 965.820	.258 .215 .172 .00202224 .0224081 11.0813 494.500	.301 .258 .215 .00349444 .0337633 9.66202 286.169	.344 .301 .258 .00554904 .0474577 8.55242 180.211	.387 .344 .301 .00828311 .0634954 7.66564 120.728	.430 .387 .344 .0117937 .0818782 6.94252 84.7908	.473 .430 .387 .0161779 .102607 6.34241 61.8125	.516 .473 .430 .0215328 .125883 5.83682 46.4406	.559 .516 .473 .0279555 .151107 5.40528 35.7711
.044	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.176 .132 .088 .000426878 .00684684 16.0394 2342.59	.220 .176 .132 .00101186 .0137005 13.5399 988.281	.264 .220 .176 .00197629 .0229302 11.6027 506.000	.308 .264 .220 .00341502 .0345485 10.1166 292.824	.352 .308 .264 .00542293 .0485614 8.98483 184.402	.396 .352 .308 .00809487 .0649720 8.02633 123.535	.440 .396 .352 .0115257 .0837823 7.26918 86.7627	.484 .440 .396 .0158103 .104994 6.64084 63.2500	.528 .484 .440 .0210435 .128606 6.11146 47.5207	.572 .528 .484 .0278302 .154681 5.65961 36.6030
.045	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.180 .135 .090 .000417391 .00700245 16.7767 2395.83	.225 .180 .135 .00098971 .0140118 14.1623 1010.74	.270 .225 .180 .00193237 .0234613 12.1361 517.500	.315 .270 .225 .00333913 .0353337 10.5817 299.479	.360 .315 .270 .00530241 .0498651 9.36650 188.593	.405 .360 .315 .00791497 .0664487 8.39531 126.343	.450 .405 .360 .0112696 .0856865 7.60335 88.7548	.495 .450 .405 .0154589 .107380 6.94613 64.6875	.540 .495 .450 .0205758 .131529 6.39241 48.6007	.585 .540 .495 .0267130 .158136 5.91979 37.4349
.046	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.184 .138 .092 .000408317 .00715806 17.5006 2449.07	.230 .184 .138 .00096863 .0143252 14.7988 1033.20	.276 .230 .184 .00189036 .0239725 12.6814 529.000	.322 .276 .230 .00326654 .0361189 11.0372 306.134	.368 .322 .276 .00518714 .0507687 9.78741 192.784	.414 .368 .322 .00774290 .0679263 8.77258 129.150	.460 .414 .368 .0110246 .0875906 7.94503 90.7064	.506 .460 .414 .0151229 .109766 7.25827 66.1250	.552 .506 .460 .0201285 .134452 6.67967 49.6807	.598 .552 .506 .0261323 .161650 6.18581 36.8668
.047	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.188 .141 .094 .000399630 .00731367 18.3011 2502.31	.235 .188 .141 .00094727l .0146346 15.4492 1055.66	.282 .235 .188 .00185014 .0244936 13.2388 540.500	.329 .282 .235 .00319704 .0369041 11.5432 312.789	.376 .329 .282 .00507678 .0518724 10.2176 196.975	.423 .376 .329 .00757817 .0694019 9.15614 131.958	.470 .423 .376 .0107900 .0894948 8.29423 92.6783	.517 .470 .423 .0148011 .112152 7.57728 67.5625	.564 .517 .470 .0197003 .137575 6.97325 50.7607	.611 .564 .517 .0255763 .165164 6.45768 39.0997
.048	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.192 .144 .096 .000391304 .00746928 19.0982 2555.56	.240 .192 .144 .00092535 .0149459 16.1136 1078.13	.288 .240 .192 .00181159 .0250148 13.8081 552.000	.336 .288 .240 .00313043 .0376893 12.0396 319.444	.384 .336 .288 .00497101 .0529761 10.6570 201.166	.432 .384 .336 .00742028 .0708786 9.55800 134.766	.480 .432 .384 .0105652 .0913989 8.65095 94.6502	.528 .480 .432 .0144927 .114338 7.90315 69.0000	.576 .528 .480 .0192898 .140298 7.27124 51.8407	.624 .576 .528 .0250434 .168678 6.73540 39.8306
.049	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.196 .147 .098 .000383319 .00762489 19.8918 2608.80	.245 .196 .147 .00090609 .0152573 16.7920 1100.59	.294 .245 .196 .00177463 .0255359 14.3895 563.500	.343 .294 .245 .00306655 .0384745 12.5465 326.100	.392 .343 .294 .00486957 .0540797 11.1057 205.357	.441 .392 .343 .00726887 .0723552 9.95414 137.573	.490 .441 .392 .0103496 .0933051 9.01514 96.6221	.539 .490 .441 .0141970 .116926 8.23588 70.4375	.588 .539 .490 .0188962 .143221 7.57934 52.9207	.637 .588 .539 .0245384 .172192 7.01897 40.7624
.050	O.D.= Outside Dia. P.D.= Pitch Dia. I.D.= Inside Dia. F_t = Def./coil/lb. F_s = Max.Def./coil F_M = Max.Load R_t = Rate Factor	.200 .150 .100 .000375632 .00780050 20.7120 2662.04	.250 .200 .150 .00089043S .0155687 17.4844 1123.05	.300 .250 .200 .00173913 .0260570 14.9828 575.000	.350 .300 .250 .00300522 .0392597 13.0638 332.755	.400 .350 .300 .00477217 .0551834 11.5636 209.548	.450 .400 .350 .00712548 .0736319 10.3646 140.381	.500 .450 .400 .0101426 .0952072 9.35688 95.5943	.550 .500 .450 .0139130 .119311 8.57546 71.8750	.600 .550 .500 .0185183 .146144 7.89186 54.0008	.650 .600 .550 .0240417 .175706 7.30838 41.5943

WIRE	SPRING INDEX ⟶	3	4	5	6	7	8	9	10	11	12
.051	O.D.- Outside Dia.	.204	.255	.306	.357	.408	.459	.510	.561	.612	.663
	P.D.- Pitch Dia.	.153	.204	.255	.306	.357	.408	.459	.510	.561	.612
	I.D.- Inside Dia.	.102	.153	.204	.255	.306	.357	.408	.459	.510	.561
	F_1 - Def./coil/lb.	.000368286	.000872973	.00170503	.00294629	.00467859	.00698379	.00994371	.0136402	.0181851	.0235703
	F_2 - Max.Def./coil	.00793611	.0158801	.0265782	.0400449	.0562871	.0753085	.0971113	.121697	.149066	.179220
	F_M - Max.Load	21.5487	18.1907	15.5681	13.5916	12.0307	10.7833	9.76606	8.92191	8.21069	7.60364
	R_1 - Rate Factor	2715.26	1145.51	586.500	339.410	213.739	143.188	100.566	73.3125	55.0808	42.4262
.052	O.D.- Outside Dia.	.208	.260	.312	.364	.416	.468	.520	.572	.624	.676
	P.D.- Pitch Dia.	.156	.208	.260	.312	.364	.416	.468	.520	.572	.624
	I.D.- Inside Dia.	.104	.156	.208	.260	.312	.364	.416	.468	.520	.572
	F_1 - Def./coil/lb.	.000361205	.000856189	.00167224	.00288964	.00458864	.00684951	.00975252	.0133779	.0178060	.0231171
	F_2 - Max.Def./coil	.00809172	.0161914	.0270993	.0408301	.0573907	.0767851	.0990155	.124083	.151989	.182734
	F_M - Max.Load	22.4021	18.9111	16.2054	14.1299	12.5072	11.2103	10.1528	9.27522	8.53584	7.90474
	R_1 - Rate Factor	2768.52	1167.97	598.000	346.065	217.930	145.996	102.538	74.7500	56.1608	43.2581
.053	O.D.- Outside Dia.	.212	.265	.318	.371	.424	.477	.530	.583	.636	.689
	P.D.- Pitch Dia.	.159	.212	.265	.318	.371	.424	.477	.530	.583	.636
	I.D.- Inside Dia.	.106	.159	.212	.265	.318	.371	.424	.477	.530	.583
	F_1 - Def./coil/lb.	.000354388	.000840032	.00164069	.00283511	.00450205	.00672025	.00956849	.0131255	.0174700	.0226809
	F_2 - Max.Def./coil	.00824733	.0165028	.0276205	.0416153	.0584944	.0782618	.100920	.126469	.154912	.186248
	F_M - Max.Load	23.2720	19.6454	16.8347	14.6785	12.9928	11.6456	10.5471	9.63539	8.86730	8.21169
	R_1 - Rate Factor	2821.76	1190.43	609.500	352.720	222.121	148.804	104.510	76.1875	57.2408	44.0900
.054	O.D.- Outside Dia.	.216	.270	.324	.378	.432	.486	.540	.594	.648	.702
	P.D.- Pitch Dia.	.162	.216	.270	.324	.378	.432	.486	.540	.594	.648
	I.D.- Inside Dia.	.108	.162	.216	.270	.324	.378	.432	.486	.540	.594
	F_1 - Def./coil/lb.	.000347826	.000824476	.00161030	.00278261	.00441868	.00659581	.00939129	.0128824	.0171465	.0222608
	F_2 - Max.Def./coil	.00840294	.0168142	.0281416	.0424005	.0595981	.0797364	.102824	.128856	.157835	.189763
	F_M - Max.Load	24.1584	20.3938	17.4759	15.2377	13.4878	12.0892	10.9488	10.0024	9.20507	8.52449
	R_1 - Rate Factor	2875.00	1212.89	621.000	359.375	226.312	151.611	106.481	77.6250	58.3208	44.9219
.055	O.D.- Outside Dia.	.220	.275	.330	.385	.440	.495	.550	.605	.660	.715
	P.D.- Pitch Dia.	.165	.220	.275	.330	.385	.440	.495	.550	.605	.660
	I.D.- Inside Dia.	.110	.165	.220	.275	.330	.385	.440	.495	.550	.605
	F_1 - Def./coil/lb.	.000341502	.000809485	.00158103	.00273201	.00433834	.00647588	.00922054	.0126482	.0168348	.0218561
	F_2 - Max.Def./coil	.00855855	.0171256	.0286627	.0431857	.0607017	.0812150	.104728	.131242	.160758	.193277
	F_M - Max.Load	25.0615	21.1561	18.1292	15.8072	13.9919	12.5411	11.3581	10.3763	9.54915	8.84314
	R_1 - Rate Factor	2928.24	1235.35	632.500	366.030	230.503	154.419	108.453	79.0625	59.4008	45.7538
.056	O.D.- Outside Dia.	.224	.280	.336	.392	.448	.504	.560	.616	.672	.728
	P.D.- Pitch Dia.	.168	.224	.280	.336	.392	.448	.504	.560	.616	.672
	I.D.- Inside Dia.	.112	.168	.224	.280	.336	.392	.448	.504	.560	.616
	F_1 - Def./coil/lb.	.000335403	.000795029	.00155279	.00268322	.00426086	.00636023	.00905588	.0124223	.0165341	.0214658
	F_2 - Max.Def./coil	.00871416	.0174369	.0291839	.0439708	.0618054	.0826917	.106632	.133628	.163681	.196791
	F_M - Max.Load	25.9811	21.9324	18.7944	16.3873	14.5054	13.0013	11.7749	10.7571	9.89955	9.16763
	R_1 - Rate Factor	2981.48	1257.81	644.000	372.685	234.694	157.227	110.425	80.5000	60.4808	46.5856
.057	O.D.- Outside Dia.	.228	.285	.342	.399	.456	.513	.570	.627	.684	.741
	P.D.- Pitch Dia.	.171	.228	.285	.342	.399	.456	.513	.570	.627	.684
	I.D.- Inside Dia.	.114	.171	.228	.285	.342	.399	.456	.513	.570	.627
	F_1 - Def./coil/lb.	.000329520	.000781085	.00152556	.00263616	.00418613	.00624868	.00889705	.0122045	.0162441	.0210893
	F_2 - Max.Def./coil	.00886977	.0177483	.0297050	.0447560	.0629091	.0841683	.108536	.136014	.166604	.200305
	F_M - Max.Load	26.9173	22.7227	19.4716	16.9778	15.0280	13.4698	12.1992	11.1447	10.2563	9.49797
	R_1 - Rate Factor	3034.72	1280.27	655.500	379.340	238.885	160.034	112.397	81.9375	61.5609	47.4175
.058	O.D.- Outside Dia.	.232	.290	.348	.406	.464	.522	.580	.638	.696	.754
	P.D.- Pitch Dia.	.174	.232	.290	.348	.406	.464	.522	.580	.638	.696
	I.D.- Inside Dia.	.116	.174	.232	.290	.348	.406	.464	.522	.580	.638
	F_1 - Def./coil/lb.	.000323838	.000767617	.00149925	.00259071	.00411395	.00614094	.00874364	.0119940	.0159640	.0207257
	F_2 - Max.Def./coil	.00902538	.0180597	.0302262	.0455412	.0640127	.0856449	.110440	.138401	.169527	.203819
	F_M - Max.Load	27.8700	23.5270	20.1609	17.5787	15.5599	13.9466	12.6310	11.5391	10.6193	9.83418
	R_1 - Rate Factor	3087.96	1302.73	667.000	385.995	243.076	162.842	114.369	83.3750	62.6409	48.2494
.059	O.D.- Outside Dia.	.236	.295	.354	.413	.472	.531	.590	.649	.708	.767
	P.D.- Pitch Dia.	.177	.236	.295	.354	.413	.472	.531	.590	.649	.708
	I.D.- Inside Dia.	.118	.177	.236	.295	.354	.413	.472	.531	.590	.649
	F_1 - Def./coil/lb.	.000318350	.000754608	.00147384	.00254680	.00404423	.00603686	.00859546	.0117907	.0156935	.0203744
	F_2 - Max.Def./coil	.00918099	.0183711	.0307473	.0463264	.0651164	.0871216	.112344	.140787	.172449	.207333
	F_M - Max.Load	28.8394	24.3452	20.8620	18.1901	16.1011	14.4316	13.0703	11.9405	10.9886	10.1762
	R_1 - Rate Factor	3141.20	1325.20	678.500	392.650	247.267	165.649	116.341	84.8125	63.7209	49.0813
.060	O.D.- Outside Dia.	.240	.300	.360	.420	.480	.540	.600	.660	.720	.780
	P.D.- Pitch Dia.	.180	.240	.300	.360	.420	.480	.540	.600	.660	.720
	I.D.- Inside Dia.	.120	.180	.240	.300	.360	.420	.480	.540	.600	.660
	F_1 - Def./coil/lb.	.000313044	.000742030	.00144928	.00250435	.00397682	.00593624	.00845219	.0115942	.0154319	.0200348
	F_2 - Max.Def./coil	.00933660	.0186824	.0312684	.0471116	.0662201	.0885982	.114249	.145173	.179372	.216847
	F_M - Max.Load	29.8252	25.1775	21.5752	18.8119	16.6516	14.9250	13.5171	12.3487	11.3643	10.5241
	R_1 - Rate Factor	3194.44	1347.66	690.000	399.306	251.458	168.457	118.313	86.2500	64.8009	49.9132

Helical Spring Tables

WIRE	SPRING INDEX ⟶	3	4	5	6	7	8	9	10	11	12
.061	O.D.= Outside Dia.	.244	.305	.366	.427	.488	.549	.610	.671	.732	.793
	P.D.= Pitch Dia.	.183	.244	.305	.366	.427	.488	.549	.610	.671	.732
	I.D.= Inside Dia.	.122	.183	.244	.305	.366	.427	.488	.549	.610	.671
	P_1 = Def./coil/lb.	.000307811	.000729863	.00142551	.00246329	.00391161	.00583980	.00831359	.0114041	.0151789	.0197063
	P_2 = Max.Def./coil	.00949221	.0109938	.0317986	.0478968	.0673237	.0900749	.1161153	.145559	.178295	.214361
	P_3 = Max.Load	30.8277	26.0237	22.3004	19.4442	17.2112	15.4266	13.9714	12.7637	11.7462	10.8778
	R_1 = Rate Factor	3247.69	1370.12	701.500	405.961	255.649	171.265	120.253	87.6875	65.9809	50.7451
.062	O.D.= Outside Dia.	.248	.310	.372	.434	.496	.558	.620	.682	.744	.806
	P.D.= Pitch Dia.	.186	.248	.310	.372	.434	.496	.558	.620	.682	.744
	I.D.= Inside Dia.	.124	.186	.248	.310	.372	.434	.496	.558	.620	.682
	P_1 = Def./coil/lb.	.000302945	.000718091	.00140262	.00242356	.003848852	.00574473	.00817951	.0112202	.0149341	.0193885
	P_2 = Max.Def./coil	.00964782	.0193052	.0383107	.0486820	.0684274	.0915515	.116057	.147945	.181218	.217876
	P_3 = Max.Load	31.8467	26.8840	23.0375	20.0870	17.7802	15.9366	14.4332	13.1856	12.1345	11.2374
	R_1 = Rate Factor	3500.93	1592.58	713.000	412.616	259.840	174.072	122.287	89.1250	66.9509	51.5770
.063	O.D.= Outside Dia.	.252	.315	.378	.441	.504	.567	.630	.693	.756	.819
	P.D.= Pitch Dia.	.189	.252	.315	.378	.441	.504	.567	.630	.693	.756
	I.D.= Inside Dia.	.126	.189	.252	.315	.378	.441	.504	.567	.630	.693
	P_1 = Def./coil/lb.	.000298136	.000706694	.00138026	.00238509	.00378744	.00565365	.00804986	.0110421	.0146970	.0190807
	P_2 = Max.Def./coil	.00980343	.0196166	.0328319	.0494872	.0696311	.0930281	.119961	.150332	.184141	.221390
	P_3 = Max.Load	32.8823	27.7582	23.7867	20.7402	18.3583	16.4548	14.9026	13.6144	12.5291	11.6028
	R_1 = Rate Factor	3354.17	1415.04	724.500	419.271	264.031	176.880	124.228	90.5625	68.0409	52.4069
.064	O.D.= Outside Dia.	.256	.320	.384	.448	.512	.576	.640	.704	.768	.832
	P.D.= Pitch Dia.	.192	.256	.320	.384	.448	.512	.576	.640	.704	.768
	I.D.= Inside Dia.	.128	.192	.256	.320	.384	.448	.512	.576	.640	.704
	P_1 = Def./coil/lb.	.000293478	.000695652	.00135070	.00234783	.00372826	.00556522	.00792391	.0108696	.0144674	.0187826
	P_2 = Max.Def./coil	.0095904	.0199279	.0333530	.0502524	.0706348	.0945048	.121865	.152718	.187064	.224904
	P_3 = Max.Load	33.9345	28.6464	24.5478	21.4038	18.9458	16.9813	15.3794	14.0500	12.9300	11.9740
	R_1 = Rate Factor	3407.41	1437.50	736.000	425.926	268.222	179.688	126.200	92.0000	69.1210	53.2407
.065	O.D.= Outside Dia.	.260	.325	.390	.455	.520	.585	.650	.715	.780	.845
	P.D.= Pitch Dia.	.195	.260	.325	.390	.455	.520	.585	.650	.715	.780
	I.D.= Inside Dia.	.130	.195	.260	.325	.390	.455	.520	.585	.650	.715
	P_1 = Def./coil/lb.	.000288963	.000684949	.00133779	.00231170	.00367090	.00547859	.00780200	.0107023	.0142448	.0184936
	P_2 = Max.Def./coil	.0101146	.0202393	.0338741	.0510376	.0717384	.0959814	.123769	.155104	.189987	.228418
	P_3 = Max.Load	35.0032	29.5486	25.3209	22.0779	19.5424	17.5161	15.9638	14.4925	13.3372	12.3512
	R_1 = Rate Factor	3460.65	1459.96	747.500	432.581	272.413	182.495	128.172	93.4375	70.2010	54.0786
.066	O.D.= Outside Dia.	.264	.330	.396	.462	.528	.594	.660	.726	.792	.858
	P.D.= Pitch Dia.	.198	.264	.330	.396	.462	.528	.594	.660	.726	.792
	I.D.= Inside Dia.	.132	.198	.264	.330	.396	.462	.528	.594	.660	.726
	P_1 = Def./coil/lb.	.000284585	.000674571	.00131752	.00227668	.00361528	.00539657	.00768379	.0105402	.0140290	.0182134
	P_2 = Max.Def./coil	.0102703	.0205507	.0343953	.0518228	.0728421	.0974580	.125674	.157490	.192910	.231932
	P_3 = Max.Load	36.0985	30.4648	26.1060	22.7624	20.1484	18.0592	16.3557	14.9419	13.7508	12.7341
	R_1 = Rate Factor	3513.89	1482.42	759.000	439.236	276.603	185.303	130.144	94.8750	71.2810	54.9045
.067	O.D.= Outside Dia.	.268	.335	.402	.469	.536	.603	.670	.737	.804	.871
	P.D.= Pitch Dia.	.201	.268	.335	.402	.469	.536	.603	.670	.737	.804
	I.D.= Inside Dia.	.134	.201	.268	.335	.402	.469	.536	.603	.670	.737
	P_1 = Def./coil/lb.	.000280338	.000664505	.00129786	.00224270	.00356133	.00531604	.00756912	.0103829	.0138196	.0179416
	P_2 = Max.Def./coil	.0104259	.0208621	.0349164	.0526080	.0739458	.0989347	.127578	.159876	.196852	.238446
	P_3 = Max.Load	37.1904	31.3949	26.9031	23.4574	20.7656	18.6106	16.8550	15.3981	14.1706	13.1229
	R_1 = Rate Factor	3567.13	1504.08	770.500	445.991	280.794	188.110	132.116	96.3125	72.3610	55.7364
.068	O.D.= Outside Dia.	.272	.340	.408	.476	.544	.612	.680	.748	.816	.884
	P.D.= Pitch Dia.	.204	.272	.340	.408	.476	.544	.612	.680	.748	.816
	I.D.= Inside Dia.	.136	.204	.272	.340	.408	.476	.544	.612	.680	.748
	P_1 = Def./coil/lb.	.000276215	.000654732	.00127877	.00220972	.00350896	.00525786	.00745781	.0102502	.0136164	.0176778
	P_2 = Max.Def./coil	.0105815	.0211734	.0354376	.0533952	.0750494	.100411	.129482	.162263	.198755	.238960
	P_3 = Max.Load	38.3089	32.3391	27.7122	24.1629	21.3880	19.1703	17.3619	15.8612	14.5968	13.5176
	R_1 = Rate Factor	3620.37	1527.34	782.000	452.546	284.985	190.918	134.088	97.7500	73.4410	56.5683
.069	O.D.= Outside Dia.	.276	.345	.414	.483	.552	.621	.690	.759	.828	.897
	P.D.= Pitch Dia.	.207	.276	.345	.414	.483	.552	.621	.690	.759	.828
	I.D.= Inside Dia.	.138	.207	.276	.345	.414	.483	.552	.621	.690	.759
	P_1 = Def./coil/lb.	.000272213	.000645245	.00126024	.00217770	.00345811	.00516196	.00734974	.0100819	.0134191	.0174216
	P_2 = Max.Def./coil	.0107371	.0214848	.0359567	.0541784	.0761531	.101888	.131386	.164649	.201678	.242474
	P_3 = Max.Load	39.4439	33.2972	28.5532	24.9198	22.0217	19.7383	17.8763	16.3511	15.0293	13.9181
	R_1 = Rate Factor	3673.61	1549.80	793.500	459.201	289.176	193.726	136.060	99.1875	74.5210	57.4002
.070	O.D.= Outside Dia.	.280	.350	.420	.490	.560	.630	.700	.770	.840	.910
	P.D.= Pitch Dia.	.210	.280	.350	.420	.490	.560	.630	.700	.770	.840
	I.D.= Inside Dia.	.140	.210	.280	.350	.420	.490	.560	.630	.700	.770
	P_1 = Def./coil/lb.	.000268323	.000636024	.00124223	.00214658	.00340869	.00508619	.00724471	.00993788	.0132273	.0171927
	P_2 = Max.Def./coil	.0108927	.0217962	.0364799	.0549836	.0772568	.103365	.133290	.167035	.204601	.245989
	P_3 = Max.Load	40.5955	34.2694	29.3663	25.6051	23.5646	20.3146	18.3982	16.8079	15.4861	14.3244
	R_1 = Rate Factor	3726.85	1572.27	805.000	465.856	293.367	196.533	138.032	100.625	75.6011	58.2521

WIRE	SPRING INDEX →	3	4	5	6	7	8	9	10	11	12
.071	O.D.- Outside Dia.	.284	.355	.426	.497	.568	.639	.710	.781	.852	.923
	P.D.- Pitch Dia.	.213	.284	.355	.426	.497	.568	.639	.710	.781	.852
	I.D.- Inside Dia.	.142	.213	.284	.355	.426	.497	.568	.639	.710	.781
	F_1 - Def./coil/lb.	.000264544	.000627066	.00122474	.00211635	.00336068	.00501653	.00714268	.00979791	.0130410	.0169308
	F_2 - Max.Def./coil	.0110483	.0221075	.0370010	.0557488	.0783604	.104841	.135194	.169421	.207524	.249503
	F_M - Max.Load	41.7636	35.2555	30.2113	26.3419	23.3168	20.8991	18.9277	17.2916	15.9132	14.7366
	R_1 - Rate Factor	3780.09	1594.73	816.500	472.512	297.558	199.341	140.003	102.063	78.6811	59.0639
.072	O.D.- Outside Dia.	.288	.360	.432	.504	.576	.648	.720	.792	.864	.936
	P.D.- Pitch Dia.	.216	.288	.360	.432	.504	.576	.648	.720	.792	.864
	I.D.- Inside Dia.	.144	.216	.288	.360	.432	.504	.576	.648	.720	.792
	F_1 - Def./coil/lb.	.000260870	.000618358	.00120773	.00208696	.00331401	.00494686	.00704348	.00966184	.0128599	.0166957
	F_2 - Max.Def./coil	.0112039	.0224189	.0375221	.0565339	.0794641	.106318	.137098	.171808	.210447	.253017
	F_M - Max.Load	42.9484	36.2556	31.0683	27.0892	23.9782	21.4920	19.4646	17.7821	16.3646	15.1547
	R_1 - Rate Factor	3833.33	1617.19	828.000	479.167	301.749	202.148	141.975	103.500	77.7611	59.8958
.073	O.D.- Outside Dia.	.292	.365	.438	.511	.584	.657	.730	.803	.876	.949
	P.D.- Pitch Dia.	.219	.292	.365	.438	.511	.584	.657	.730	.803	.876
	I.D.- Inside Dia.	.146	.219	.292	.365	.438	.511	.584	.657	.730	.803
	F_1 - Def./coil/lb.	.000257295	.000609885	.00119118	.00205836	.00326861	.00487906	.00694698	.00952946	.0126837	.0164669
	F_2 - Max.Def./coil	.0113595	.0227303	.0380433	.0573191	.0805678	.107795	.139003	.174194	.213370	.256531
	F_M - Max.Load	44.1496	37.2697	31.9373	27.8469	24.6489	22.0931	20.0090	18.2795	16.8223	15.5785
	R_1 - Rate Factor	3886.57	1639.65	839.500	485.822	305.940	204.956	143.947	104.938	78.8411	60.7277
.074	O.D.- Outside Dia.	.296	.370	.444	.518	.592	.666	.740	.814	.888	.962
	P.D.- Pitch Dia.	.222	.296	.370	.444	.518	.592	.666	.740	.814	.888
	I.D.- Inside Dia.	.148	.222	.296	.370	.444	.518	.592	.666	.740	.814
	F_1 - Def./coil/lb.	.000253819	.000601645	.00117509	.00203055	.00322444	.00481316	.00685311	.00940070	.0125123	.0162444
	F_2 - Max.Def./coil	.0115151	.0230417	.0385644	.0581043	.0816714	.109271	.140907	.176580	.216292	.260045
	F_M - Max.Load	45.3675	38.2978	32.8183	28.6150	25.3289	22.7026	20.5610	18.7837	17.2863	16.0083
	R_1 - Rate Factor	3939.81	1662.11	851.000	492.477	310.131	207.764	145.919	106.375	79.9211	61.5596
.075	O.D.- Outside Dia.	.300	.375	.450	.525	.600	.675	.750	.825	.900	.975
	P.D.- Pitch Dia.	.225	.300	.375	.450	.525	.600	.675	.750	.825	.900
	I.D.- Inside Dia.	.150	.225	.300	.375	.450	.525	.600	.675	.750	.825
	F_1 - Def./coil/lb.	.000250434	.000593622	.00115942	.00200347	.00318144	.00474897	.00676172	.00927534	.0123455	.0160278
	F_2 - Max.Def./coil	.0116707	.0233530	.0390856	.0588895	.0827751	.110748	.142811	.178966	.219215	.263559
	F_M - Max.Load	46.6019	39.3398	33.7113	29.3936	26.0180	23.3203	21.1204	19.2948	17.7567	16.4439
	R_1 - Rate Factor	3993.06	1684.57	862.500	499.132	314.322	210.571	147.891	107.813	81.0011	62.3915
.076	O.D.- Outside Dia.	.304	.380	.456	.532	.608	.684	.760	.836	.912	.988
	P.D.- Pitch Dia.	.228	.304	.380	.456	.532	.608	.684	.760	.836	.912
	I.D.- Inside Dia.	.152	.228	.304	.380	.456	.532	.608	.684	.760	.836
	F_1 - Def./coil/lb.	.000247140	.000585813	.00114417	.00197712	.00313959	.00468650	.00667277	.00915332	.0121831	.0158169
	F_2 - Max.Def./coil	.0118264	.0236644	.0396067	.0596747	.0838788	.112224	.144715	.181352	.222138	.267073
	F_M - Max.Load	47.8530	40.3959	34.6163	30.1827	26.7165	23.9463	21.6874	19.8128	18.2334	16.8853
	R_1 - Rate Factor	4046.30	1707.03	874.000	505.787	318.513	213.379	149.863	109.250	82.0811	63.2234
.077	O.D.- Outside Dia.	.308	.385	.462	.539	.616	.693	.770	.847	.924	1.001
	P.D.- Pitch Dia.	.231	.308	.385	.462	.539	.616	.693	.770	.847	.924
	I.D.- Inside Dia.	.154	.231	.308	.385	.462	.539	.616	.693	.770	.847
	F_1 - Def./coil/lb.	.000243930	.000578204	.00112930	.00195144	.00309861	.00462563	.00658610	.00903443	.0120248	.0156115
	F_2 - Max.Def./coil	.0119820	.0239758	.0401278	.0604599	.0849824	.113701	.146619	.183739	.225061	.270587
	F_M - Max.Load	49.1205	41.4659	35.5332	30.9822	27.4242	24.5806	22.2619	20.3376	18.7163	17.3325
	R_1 - Rate Factor	4099.54	1729.49	885.500	512.442	322.704	216.187	151.835	110.688	83.1612	64.0553
.078	O.D.- Outside Dia.	.312	.390	.468	.546	.624	.702	.780	.858	.936	1.014
	P.D.- Pitch Dia.	.234	.312	.390	.468	.546	.624	.702	.780	.858	.936
	I.D.- Inside Dia.	.156	.234	.312	.390	.468	.546	.624	.702	.780	.858
	F_1 - Def./coil/lb.	.000240802	.000570791	.00111483	.00192642	.00305908	.00456633	.00650167	.00891861	.0118707	.0154114
	F_2 - Max.Def./coil	.0121376	.0242872	.0406490	.0612451	.0860861	.115178	.148523	.186125	.227984	.274102
	F_M - Max.Load	50.4047	42.5500	36.4621	31.7922	28.1411	25.2232	22.8439	20.8692	19.2056	17.7857
	R_1 - Rate Factor	4152.78	1751.95	897.000	519.097	326.895	218.994	153.807	112.125	84.2412	64.8872
.079	O.D.- Outside Dia.	.316	.395	.474	.553	.632	.711	.790	.869	.948	1.027
	P.D.- Pitch Dia.	.237	.316	.395	.474	.553	.632	.711	.790	.869	.948
	I.D.- Inside Dia.	.158	.237	.316	.395	.474	.553	.632	.711	.790	.869
	F_1 - Def./coil/lb.	.000237754	.000563565	.00110071	.00190203	.00302036	.00450852	.00641936	.00880570	.0117204	.0152163
	F_2 - Max.Def./coil	.0122932	.0245985	.0411701	.0620303	.0871898	.116654	.150427	.188511	.230907	.277616
	F_M - Max.Load	51.7054	43.6480	37.4031	32.6126	28.8673	25.8741	23.4333	21.4078	19.7012	18.2446
	R_1 - Rate Factor	4206.02	1774.41	908.500	525.752	331.086	221.802	155.778	113.563	85.3212	65.7190
.080	O.D.- Outside Dia.	.320	.400	.480	.560	.640	.720	.800	.880	.960	1.040
	P.D.- Pitch Dia.	.240	.320	.400	.480	.560	.640	.720	.800	.880	.960
	I.D.- Inside Dia.	.160	.240	.320	.400	.480	.560	.640	.720	.800	.880
	F_1 - Def./coil/lb.	.000234783	.000556522	.00108696	.00187826	.00298261	.00445217	.00633913	.00869565	.0115739	.0150261
	F_2 - Max.Def./coil	.0124488	.0249099	.0416913	.0628155	.0882934	.118131	.152332	.190897	.233830	.281130
	F_M - Max.Load	53.0227	44.7600	38.3560	33.4434	29.6028	26.5333	24.0303	21.9532	20.2032	18.7094
	R_1 - Rate Factor	4259.26	1796.88	920.000	532.407	335.277	224.609	157.750	115.000	86.4012	66.5509

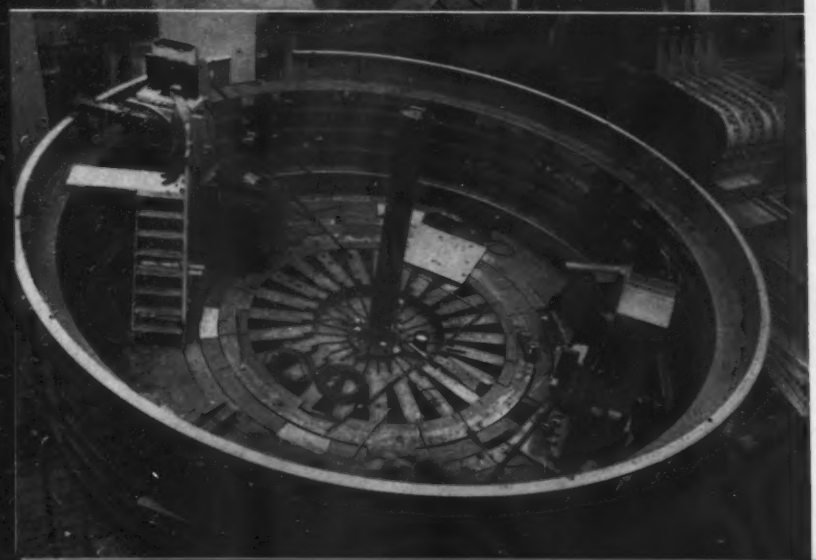
Helical Spring Tables

WIRE	SPRING INDEX ——→	3	4	5	6	7	8	9	10	11	12
.081	O.D.= Outside Dia.	.324	.405	.486	.567	.648	.729	.810	.891	.972	1.053
	P.D.= Pitch Dia.	.243	.324	.405	.486	.567	.648	.729	.810	.891	.972
	I.D.= Inside Dia.	.162	.243	.324	.405	.486	.567	.648	.729	.810	.891
	P_c = Def./coil/lb.	.0002231884	.0008840662	.00107354	.0018556B	.00294579	.00439722	.00626085	.00858851	.0114310	.0148406
	P_t = Max.Def./coil	.0126044	.0252213	.0428184	.0656007	.0993971	.139808	.184256	.193884	.258783	.304644
	P_m = Max.Load	54.3565	45.8060	39.5208	34.2847	30.3475	27.2008	24.6349	22.5084	20.7114	19.1801
	R_t = Rate Factor	4312.50	1819.34	931.500	539.062	339.468	227.417	159.722	116.438	87.4812	67.3828
.082	O.D.= Outside Dia.	.328	.410	.492	.574	.656	.738	.820	.902	.984	1.066
	P.D.= Pitch Dia.	.246	.328	.410	.492	.574	.656	.738	.820	.902	.984
	I.D.= Inside Dia.	.164	.246	.328	.410	.492	.574	.656	.738	.820	.902
	P_c = Def./coil/lb.	.0002290056	.0009382947	.00386044	.0018382B45	.00290986	.00454358	.00681451	.00968585	.0112916	.0148556
	P_t = Max.Def./coil	.0127000	.0255387	.0427355	.0657711	.0995008	.139808	.156140	.196670	.239675	.288158
	P_m = Max.Load	58.7069	47.0260	40.2977	35.1365	31.1014	27.8766	25.8469	23.0446	21.2850	19.6548
	R_t = Rate Factor	4365.74	1841.80	945.000	545.718	345.659	230.225	161.694	117.876	88.5612	68.2147
.083	O.D.= Outside Dia.	.332	.415	.498	.581	.664	.747	.830	.913	.996	1.079
	P.D.= Pitch Dia.	.249	.332	.415	.498	.581	.664	.747	.830	.913	.996
	I.D.= Inside Dia.	.166	.249	.332	.415	.498	.581	.664	.747	.830	.913
	P_c = Def./coil/lb.	.0002263697	.0008536407	.00104767	.0018103037	.00297481	.00429125	.00611001	.00838136	.0111556	.0144850
	P_t = Max.Def./coil	.0129156	.0258440	.0432547	.0653711	.0916044	.122561	.158044	.198056	.244598	.291672
	P_m = Max.Load	57.0759	48.1799	41.9866	35.9987	31.4646	28.2456	25.8664	23.8508	21.7466	20.1390
	R_t = Rate Factor	4418.98	1864.25	954.563	558.375	347.850	233.032	163.666	119.313	89.6418	69.0466
.084	O.D.= Outside Dia.	.336	.420	.504	.588	.672	.756	.840	.924	1.008	1.092
	P.D.= Pitch Dia.	.252	.336	.420	.504	.588	.672	.756	.840	.924	1.008
	I.D.= Inside Dia.	.168	.252	.336	.420	.504	.588	.672	.756	.840	.924
	P_c = Def./coil/lb.	.0002223603	.0008530922	.00103580	.0017B803	.00294059	.00424018	.00603729	.00B28160	.0110888	.0145106
	P_t = Max.Def./coil	.0130712	.0261554	.0437768	.0659563	.0927581	.124058	.159948	.200442	.245681	.295186
	P_m = Max.Load	59.4575	49.3479	42.2874	36.8714	32.5370	29.2330	26.4935	24.7534	22.9740	20.4972
	R_t = Rate Factor	4472.22	1886.72	966.000	559.298	352.041	235.840	165.638	120.750	90.7813	69.8785
.085	O.D.= Outside Dia.	.340	.425	.510	.595	.680	.765	.850	.935	1.020	1.105
	P.D.= Pitch Dia.	.255	.340	.425	.510	.595	.680	.765	.850	.935	1.020
	I.D.= Inside Dia.	.170	.255	.340	.425	.510	.595	.680	.765	.850	.935
	P_c = Def./coil/lb.	.0002209972	.0008523785	.00102302	.00176777	.00280716	.00419028	.00596624	.00818414	.0108931	.0141422
	P_t = Max.Def./coil	.0132268	.0264668	.0442970	.0667415	.0938118	.125514	.161858	.202828	.249444	.299700
	P_m = Max.Load	59.8576	50.3298	43.3003	37.7545	33.4187	29.9556	27.1280	24.7831	22.8075	21.1312
	R_t = Rate Factor	4525.46	1909.18	977.500	565.683	356.232	238.647	167.610	122.188	91.8015	70.7104
.086	O.D.= Outside Dia.	.344	.430	.516	.602	.688	.774	.860	.946	1.032	1.118
	P.D.= Pitch Dia.	.258	.344	.430	.516	.602	.688	.774	.860	.946	1.032
	I.D.= Inside Dia.	.172	.258	.344	.430	.516	.602	.688	.774	.860	.946
	P_c = Def./coil/lb.	.0002184402	.0008517694	.00101112	.00174722	.00277452	.00414155	.00589856	.00808897	.0107664	.0139777
	P_t = Max.Def./coil	.0133825	.0267782	.0448181	.0675267	.0949185	.126991	.165756	.205215	.251367	.302215
	P_m = Max.Load	61.2743	51.7258	44.3251	38.6481	34.2097	30.6626	27.7701	25.3697	23.3473	21.6211
	R_t = Rate Factor	4578.70	1931.64	989.000	572.338	360.423	241.455	169.582	123.625	92.8813	71.6422
.087	O.D.= Outside Dia.	.348	.435	.522	.609	.696	.783	.870	.957	1.044	1.131
	P.D.= Pitch Dia.	.261	.348	.435	.522	.609	.696	.783	.870	.957	1.044
	I.D.= Inside Dia.	.174	.261	.348	.435	.522	.609	.696	.783	.870	.957
	P_c = Def./coil/lb.	.0002158693	.0008511746	.0009998504	.00172714	.00274264	.00409397	.00582911	.00799603	.0106427	.0138171
	P_t = Max.Def./coil	.0135381	.0270895	.0453592	.0683119	.0960191	.128467	.165651	.207601	.254290	.305729
	P_m = Max.Load	62.7076	52.9357	45.3619	39.5821	35.0099	31.3798	28.4196	25.9831	23.8934	22.1266
	R_t = Rate Factor	4631.94	1954.10	1000.50	578.993	364.614	244.263	171.553	125.063	93.9613	72.3741
.088	O.D.= Outside Dia.	.352	.440	.528	.616	.704	.792	.880	.968	1.056	1.144
	P.D.= Pitch Dia.	.264	.352	.440	.528	.616	.704	.792	.880	.968	1.056
	I.D.= Inside Dia.	.176	.264	.352	.440	.528	.616	.704	.792	.880	.968
	P_c = Def./coil/lb.	.0002153438	.0008505927	.0009988139	.00170780	.00271145	.00404742	.00576283	.00790511	.0105217	.0136600
	P_t = Max.Def./coil	.0136937	.0274009	.0458604	.0690970	.0971228	.129944	.167565	.209987	.257213	.309243
	P_m = Max.Load	64.1874	54.1596	46.4107	40.4666	35.8193	32.1053	29.0767	26.5634	24.4458	22.6384
	R_t = Rate Factor	4685.19	1976.56	1012.00	585.648	368.805	247.070	173.585	126.800	95.0413	73.2060
.089	O.D.= Outside Dia.	.356	.445	.534	.623	.712	.801	.890	.979	1.068	1.157
	P.D.= Pitch Dia.	.267	.356	.445	.534	.623	.712	.801	.890	.979	1.068
	I.D.= Inside Dia.	.178	.267	.356	.445	.534	.623	.712	.801	.890	.979
	P_c = Def./coil/lb.	.0002211041	.0008502246	.0009977043	.00168853	.00268101	.00400197	.00569012	.00781655	.0104036	.0135066
	P_t = Max.Def./coil	.0138493	.0277123	.0463815	.0698822	.0982865	.131421	.169469	.212373	.260136	.318757
	P_m = Max.Load	65.6238	55.3975	47.4715	41.3915	36.8380	32.8391	29.7413	27.1705	25.0046	23.1559
	R_t = Rate Factor	4738.43	1999.02	1025.50	592.303	372.996	249.878	175.497	127.958	96.1213	74.0379
.090	O.D.= Outside Dia.	.360	.450	.540	.630	.720	.810	.900	.990	1.080	1.170
	P.D.= Pitch Dia.	.270	.360	.450	.540	.630	.720	.810	.900	.990	1.080
	I.D.= Inside Dia.	.180	.270	.360	.450	.540	.630	.720	.810	.900	.990
	P_c = Def./coil/lb.	.0002208695	.0008494685	.0009986183	.00166956	.00265121	.00395748	.00563478	.00772946	.0102879	.0133566
	P_t = Max.Def./coil	.0140049	.0280237	.0469027	.0706674	.0993501	.132897	.171373	.214759	.263058	.316271
	P_m = Max.Load	67.1068	56.6494	48.5443	42.3268	37.4660	33.5812	30.4134	27.7845	25.5696	23.6791
	R_t = Rate Factor	4791.67	2021.48	1035.00	598.958	377.187	252.686	177.469	129.375	97.2014	74.8690

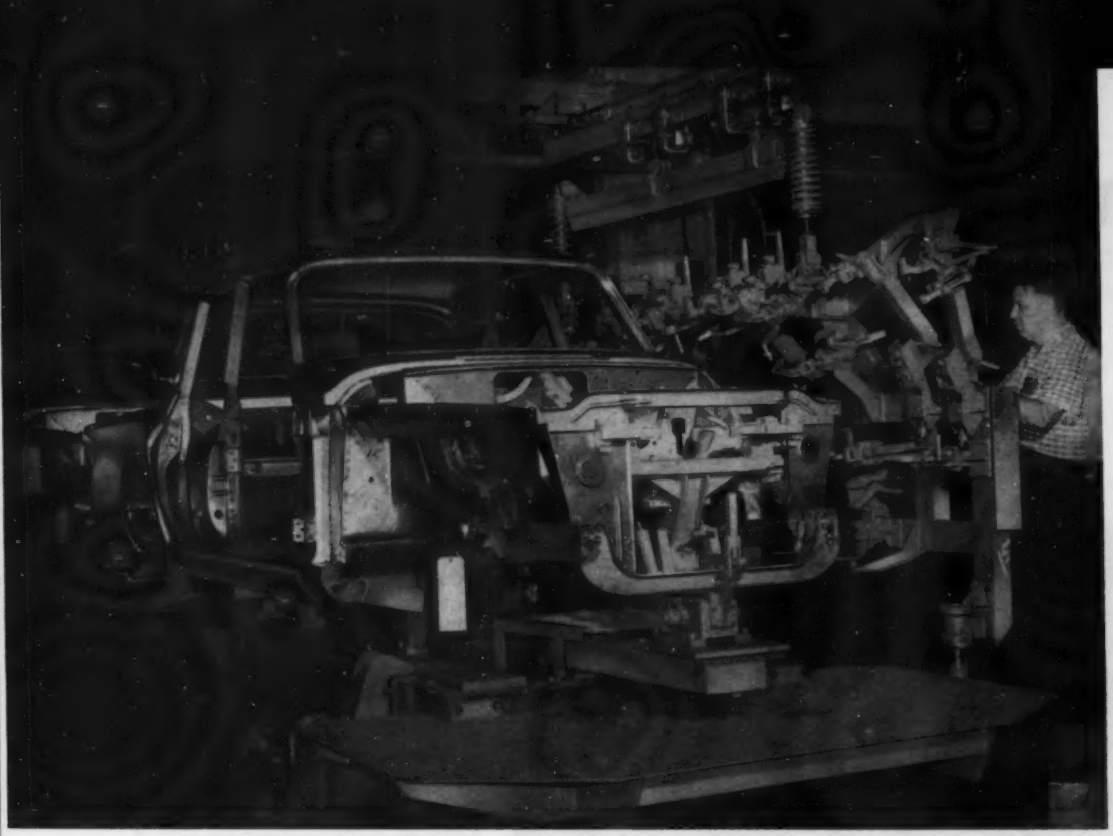
WIRE	SPRING INDEX ——→	3	4	5	6	7	8	9	10	11	12
.091	O.D.- Outside Dia.	.364	.455	.546	.637	.728	.819	.910	1.001	1.092	1.183
	P.D.- Pitch Dia.	.273	.364	.455	.546	.637	.728	.819	.910	1.001	1.092
	I.D.- Inside Dia.	.182	.273	.364	.455	.546	.637	.728	.819	.910	1.001
	F_1 - Def./coil/lb.	.000206402	.000489249	.000955565	.00165122	.00262207	.00391400	.00557285	.00764452	.0101749	.0132097
	F_2 - Max.Def./coil	.0141605	.0283350	.0474238	.0714526	.100434	.134774	.173277	.217146	.265981	.319785
	F_M - Max.Load	68.6064	57.9152	49.6290	43.2727	38.3032	34.3516	31.0930	28.4054	26.1410	24.2083
	R_1 - Rate Factor	4844.91	2043.95	1046.80	605.613	381.378	255.493	179.441	130.813	98.2814	75.7017
.092	O.D.- Outside Dia.	.368	.460	.552	.644	.736	.828	.920	1.012	1.104	1.196
	P.D.- Pitch Dia.	.276	.368	.460	.552	.644	.736	.828	.920	1.012	1.104
	I.D.- Inside Dia.	.184	.276	.368	.460	.552	.644	.736	.828	.920	1.012
	F_1 - Def./coil/lb.	.000204159	.000483933	.000945183	.00163328	.00259358	.00387147	.00551230	.00756146	.0100643	.0130682
	F_2 - Max.Def./coil	.0145161	.0286464	.0479449	.0722378	.101537	.135851	.175181	.219532	.268904	.323299
	F_M - Max.Load	70.1225	59.1961	50.7258	44.2289	39.1496	35.0903	31.7801	29.0351	26.7187	24.7432
	R_1 - Rate Factor	4898.15	2066.41	1058.00	612.269	385.569	258.301	181.412	132.260	99.3614	76.5336
.093	O.D.- Outside Dia.	.372	.465	.558	.651	.744	.837	.930	1.023	1.116	1.209
	P.D.- Pitch Dia.	.279	.372	.465	.558	.651	.744	.837	.930	1.023	1.116
	I.D.- Inside Dia.	.186	.279	.372	.465	.558	.651	.744	.837	.930	1.023
	F_1 - Def./coil/lb.	.000201964	.000478729	.000935017	.00161571	.00256569	.00382983	.00545302	.00748014	.00995607	.0129257
	F_2 - Max.Def./coil	.0144717	.0285778	.0484661	.0730230	.102641	.137327	.177085	.221918	.271827	.326813
	F_M - Max.Load	71.6552	60.4889	51.8345	45.1957	40.0054	35.8573	32.4748	29.6677	27.3027	25.2841
	R_1 - Rate Factor	4951.39	2088.87	1069.50	618.924	389.759	261.108	183.385	133.588	100.441	77.3655
.094	O.D.- Outside Dia.	.376	.470	.564	.658	.752	.846	.940	1.034	1.128	1.222
	P.D.- Pitch Dia.	.282	.376	.470	.564	.658	.752	.846	.940	1.034	1.128
	I.D.- Inside Dia.	.188	.282	.376	.470	.564	.658	.752	.846	.940	1.034
	F_1 - Def./coil/lb.	.000199815	.000473636	.000925070	.00159852	.00253839	.00378908	.00539501	.00740056	.00985014	.0127882
	F_2 - Max.Def./coil	.0146273	.0292691	.0489872	.0738082	.103745	.138804	.178990	.224304	.274750	.330328
	F_M - Max.Load	73.2044	61.7968	52.9552	46.1728	40.8703	36.6326	33.1769	30.3091	27.8930	25.8307
	R_1 - Rate Factor	5004.63	2111.33	1081.00	625.579	393.950	263.916	185.357	135.125	101.521	78.1973
.095	O.D.- Outside Dia.	.380	.475	.570	.665	.760	.855	.950	1.045	1.140	1.235
	P.D.- Pitch Dia.	.285	.380	.475	.570	.665	.760	.855	.950	1.045	1.140
	I.D.- Inside Dia.	.190	.285	.380	.475	.570	.665	.760	.855	.950	1.045
	F_1 - Def./coil/lb.	.000197711	.000468649	.000915330	.00156169	.00251167	.00374919	.00533821	.00732264	.00974644	.0126535
	F_2 - Max.Def./coil	.0147829	.0295805	.0495084	.0745934	.104848	.140281	.180894	.227673	.277673	.333842
	F_M - Max.Load	74.7702	63.1186	54.0879	47.1605	41.7445	37.4161	33.8865	30.9574	28.4896	26.3852
	R_1 - Rate Factor	5057.87	2133.79	1092.50	632.234	398.141	266.724	187.329	136.563	102.601	79.0292
.096	O.D.- Outside Dia.	.384	.480	.576	.672	.768	.864	.960	1.056	1.152	1.248
	P.D.- Pitch Dia.	.288	.384	.480	.576	.672	.768	.864	.960	1.056	1.152
	I.D.- Inside Dia.	.192	.288	.384	.480	.576	.672	.768	.864	.960	1.056
	F_1 - Def./coil/lb.	.000195653	.000463770	.000905600	.00156522	.00248552	.00371016	.00528263	.00724640	.00964496	.0125218
	F_2 - Max.Def./coil	.0149386	.0298919	.0500295	.0753786	.105952	.141757	.182798	.229077	.280596	.337356
	F_M - Max.Load	76.3526	64.4544	55.2326	48.1585	42.6280	38.2080	34.6037	31.6126	29.0926	26.9416
	R_1 - Rate Factor	5111.11	2156.25	1104.00	638.889	402.332	269.531	189.300	138.000	103.681	79.8611
.097	O.D.- Outside Dia.	.388	.485	.582	.679	.776	.873	.970	1.067	1.164	1.261
	P.D.- Pitch Dia.	.291	.388	.485	.582	.679	.776	.873	.970	1.067	1.164
	I.D.- Inside Dia.	.194	.291	.388	.485	.582	.679	.776	.873	.970	1.067
	F_1 - Def./coil/lb.	.000193636	.000458988	.000896461	.00154908	.00245989	.00367190	.00522816	.00717169	.00954552	.0123927
	F_2 - Max.Def./coil	.0150942	.0302033	.0505507	.0761638	.107056	.143234	.184702	.231463	.283519	.340870
	F_M - Max.Load	77.9516	65.8042	56.3893	49.1671	43.5207	39.0081	35.3284	32.2746	29.7018	27.5058
	R_1 - Rate Factor	5164.35	2178.71	1115.50	645.544	406.523	272.339	191.272	139.438	104.761	80.6930
.098	O.D.- Outside Dia.	.392	.490	.588	.686	.784	.882	.980	1.078	1.176	1.274
	P.D.- Pitch Dia.	.294	.392	.490	.588	.686	.784	.882	.980	1.078	1.176
	I.D.- Inside Dia.	.196	.294	.392	.490	.588	.686	.784	.882	.980	1.078
	F_1 - Def./coil/lb.	.000191660	.000454304	.000887313	.00153328	.00243479	.00363443	.00517481	.00709850	.00944811	.0122662
	F_2 - Max.Def./coil	.0152498	.0305146	.0510718	.0769490	.108159	.144710	.186606	.233849	.286441	.344384
	F_M - Max.Load	79.5671	67.1680	57.5579	50.1861	44.4226	39.8166	36.0605	32.9435	30.3174	28.0759
	R_1 - Rate Factor	5217.59	2201.17	1127.00	652.199	410.714	275.146	193.244	140.875	105.841	81.5249
.099	O.D.- Outside Dia.	.396	.495	.594	.693	.792	.891	.990	1.089	1.188	1.287
	P.D.- Pitch Dia.	.297	.396	.495	.594	.693	.792	.891	.990	1.089	1.188
	I.D.- Inside Dia.	.198	.297	.396	.495	.594	.693	.792	.891	.990	1.089
	F_1 - Def./coil/lb.	.000189723	.000449714	.000878348	.00151779	.00241019	.00359771	.00512252	.00702678	.00935265	.0121423
	F_2 - Max.Def./coil	.0154084	.0308260	.0515929	.0777342	.109263	.146187	.188510	.236235	.289364	.347898
	F_M - Max.Load	81.1992	68.5457	58.7386	51.2155	45.3336	40.6333	36.8002	33.6192	30.9395	28.6518
	R_1 - Rate Factor	5270.83	2223.63	1138.50	658.854	414.905	277.954	195.216	142.313	106.921	82.3568
.100	O.D.- Outside Dia.	.400	.500	.600	.700	.800	.900	1.000	1.100	1.200	1.300
	P.D.- Pitch Dia.	.300	.400	.500	.600	.700	.800	.900	1.000	1.100	1.200
	I.D.- Inside Dia.	.200	.300	.400	.500	.600	.700	.800	.900	1.000	1.100
	F_1 - Def./coil/lb.	.000187826	.000445217	.000869565	.00150261	.00238609	.00356174	.00507130	.00695652	.00925913	.0120209
	F_2 - Max.Def./coil	.0155610	.0311374	.0521141	.0785194	.110367	.147664	.190414	.238622	.292287	.351412
	F_M - Max.Load	82.8479	69.9375	59.9312	52.2554	46.2543	41.4583	37.5474	34.3019	31.5675	29.2335
	R_1 - Rate Factor	5324.07	2246.09	1150.00	665.509	419.096	280.762	197.188	143.750	108.002	83.1887

IN SHOPS AROUND THE COUNTRY

Camera highlights of some interesting operations performed in various metalworking plants throughout the nation by unique applications of machines and tools



MERRY-GO-ROUND——Before each of thirteen 167,000-kva water wheel generators for the New York State Power Authority's Niagara project can be shipped from Westinghouse's East Pittsburgh plant, the frame of the umbrella type stator must be machined. The work is stationed on the floor, enclosing a rotary table carrying two tooling columns. Each stator frame is about 40 feet in diameter, 10 feet high, and will weigh approximately 250 tons when completed. For shipment, it must be disassembled into four sections.



GATE LINE——Final assembly of Chrysler's new Valiant is performed on a moving base. Two gates bring the many parts of the car together in a perfect fit. First, the gate for the right-hand side of the car is positioned next to the floor pan resting on the base. This base rolls on rails and has the appearance of a flat freight car. When both gates are locked, the base continues its movement as welders work inside and outside, "unitizing" the various parts. Here, gates are unlocked and rolled away, and the car continues along the line to receive fenders, hood, doors, and rear decking at other stations.

SHOTBLASTER——Blast descaling machine provides the first step in production of nonskid safety grating at Bustin Steel Products, Dover, N. J. Hot-rolled steel bars are fed into the equipment, a Pangborn three-wheel Rotoblast, at speeds up to 180 feet per minute. Since the descaling is done just minutes prior to serrating, forming, and welding operations, the bars remain free of rust. Spent abrasive is recovered by falling into a hopper, elevated by conveyor, air-washed, and returned for re-use. At present, only one worker is required to feed the machine and even this activity will be automated when warranted by production requirements.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Fig. 1. Close-up of duplicating job handled on Gorton "Bedmill"

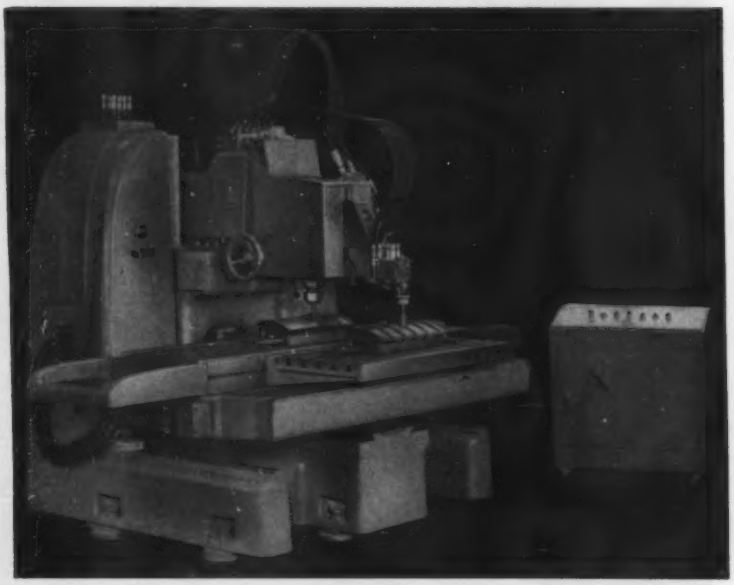


Fig. 2. "Bedmill" and equipment announced by the George Gorton Co.

Gorton "Bedmill" Built

A special machine available in fourteen models and thirty-four combinations has been brought out by the George Gorton Machine Co., Racine, Wis. This unit is designed for the aircraft and missile fields, and is especially adapted for use in plastic-mold shops and wherever coining, drop-forging, and die-casting dies are made. It will serve as a production profiling machine, a duplicator in three dimensions, and a conventional milling machine. Features include hydraulic, electrohydraulic (automatic) tracer control or numerical control in combination with the proven stability, ruggedness, and long-lived accuracy of a bed type machine. The basic machine lends itself to many different combinations of speeds and feeds—electrical and/or hydraulic—to meet various requirements.

The heavy base casting is more than 6 feet square and rests on ten leveling screws. The 84-inch saddle rides on a wide center bearing and on outboard bearing rollers which are adjustable for wear. It also travels on hardened and ground outboard supports which provide a bearing spread greater than the table travel. A large tool tray is attached to each end of the table for the convenience of the operator. The machine table and master table are both mounted horizontally and in front to facilitate loading and unloading. All controls are contained in a separate console.

This Bedmill is available with a hydraulic spindle of from 15 to 40 hp. Feeds can be specified as all hydraulic, screw, or as a combination of hydraulic and screw. The machine is available with or without front- or side-mounted "Trace-Master" hydraulic tracer

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

in Fourteen Models

for three-dimensional work with manually guided, pencil type stylus and with or without front-mounted master table. It can also be furnished with or without front- or side-mounted "Auto-Trace" electrohydraulic tracer for completely automatic duplicating (180 degrees) or for production profiling work (360 degrees) and with or without front-mounted master table.

Numerical control may also be specified by the purchaser, and will be built in at the factory. The Bedmill is also available as a conventional milling machine without tracing or numerical controls. Spindle speeds vary according to horsepower—215 to 3000 rpm for the 15-hp model and 37 to 3000 rpm for the 40-hp model. Infinitely variable speeds and lower speed ranges are available at extra cost.

A master table is furnished as a standard component of the Bedmill when it is ordered with either the Trace-Master or Auto-Trace tracing systems and where the tracer is front-mounted. This table is 52 inches long and 24 inches front to back. It is mounted at the front of the machine table and rides longitudinally on a heavy rail bolted to four heavy brackets attached to the saddle. The hydraulic system includes a 188-gallon divided-reservoir hydraulic tank and electric motor which power the hydraulic spindle and the tracer head in the case of the Trace-Master model, as well as all hydraulic feeds.

The Gorton Bedmill is built only on special order according to the specific requirements of the purchaser. Condensed specifications include: table working surface, 24 by 84 inches; five 13/16 T-slots spaced 3 3/4 inches apart; longitudinal feed of 48 inches; and cross-feed of 16 inches. The ram has a vertical movement of 24 inches and a transverse movement of 16 inches. Maximum cross range (saddle and ram) movement is 32 inches and the distance from cutter-spindle to table top ranges from 6 1/2 to 38 inches. Spindle taper is No. 50 N. S.

The tracer spindle has 5-inch vertical, 3-inch longitudinal, and 2-inch transverse movements. This machine weighs approximately 21,000 pounds, occupies a floor space about 182 inches wide by 121 inches deep, and is 120 inches high. The hydraulic tank with cooler unit is 6 feet 9 1/8 inches long and 2 feet 7 inches wide by 27 inches high, plus motor. Control-console size is dependent on electrical characteristics of the basic machine specified.

Circle Item 570 on inquiry card

"Building-Block" Components that Can Be Assembled to Form Precision Deep-Hole Drilling Machine

The Drillmation Co., Inc., Center Line, Mich., has introduced packaged "building-block" components for a deep-hole drilling machine that can be assembled by the purchaser. This package consists of the six components needed to assemble a precision machine, capable of gun drilling or boring "finished" holes in one pass—from the solid—thus eliminating many secondary and troublesome operations.

Three basic advantages are claimed for this machine. First, the purchaser can use his own labor

Six basic components of packaged precision deep-hole drilling machine introduced by Drillmation Co., Inc.

and facilities to assemble the components. Second, he can use his own machine base. In most cases an obsolete machine will supply an ideal base. Third, versatility and adaptability of the machine are important factors. The "built-in" modular "Blockmation" concept allows components to be rearranged to fit almost any job. The limitless variations in position, speeds, feeds, and capacities possible with this packaged equipment serve to facilitate the solution of a wide range of machining problems.

The package is divided into the six basic components shown in the illustration:

(1) Boremation deep-hole drilling power unit.
(2) Spindle-load meter that indicates variations in the work-piece, such as density, heat-treatment, condition of the tool, and whether the chips and coolant are functioning properly.
(3) Feed-rate meter which indicates drilling speed in inches per minute.
(4) Spindle tachometer for indicating spindle speed in revolutions per minute.
(5) Electrical-control cabinet made to JIC standards.
(6) Control panel which allows machine to be run in or out of sequence and repositioned as required.

Infinitely variable feeds and speeds can be dialed, making new setups a simple procedure. This allows different drilling setups to be employed alternately with a minimum of down time. The versatility of these units makes them ideal for machining soft metals, like aluminum, or the new tough alloys used in the aircraft and missile industries. Spindle speeds up to 10,000 rpm can be obtained with any combination of feed rates from 0.0001 to 0.025 inch per revolution. Mechanical models have strokes up to 60 inches, while hydraulic models have strokes up to 24 inches.

Circle Item 571 on inquiry card

Buhr Economatic Performs Wide Range of Precision Machining and Nonmachining Operations

Transfer machines are commonly thought of as performing only metal-cutting or related operations. An Economatic transfer machine, designed and built with standard components by Buhr Machine Tool Co., Ann Arbor, Mich., demonstrates, however, that many other types of operations can also be performed effectively on these machines. Installed at the plant of the Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Mich., this seventy-six-station, closed-loop, palletized transfer machine includes drilling, reaming, tapping, recessing, face milling, wire brushing, surface generation, precision boring, and assembly among its 220 operations. In addition, each power-steering pump housing processed on this machine is automatically gaged and marked so that it can be selectively assembled with mating components.

In this Economatic, Fig. 1, two hydraulic pump housings like the one shown at the left, Fig. 2, are manually loaded and then automatically located and clamped in each palletized fixture. These parts are finished (see view at right, Fig. 2) at the rate of 300 per hour at 100 per cent efficiency. Various surfaces are milled and some holes are drilled, reamed, spot-faced, counterbored, chamfered, and tapped. Near the end of the first 117-foot-long leg of the machine, a babbit bushing is correctly oriented with respect to the pump-shaft hole and is then pressed home. The inside diameters of these bushings are precision bored after assembly.

At one station, an air gage scans the precision-bored pump-plunger hole for size and roundness. The classifier then automatically sprays the pump housing with a small spot of paint

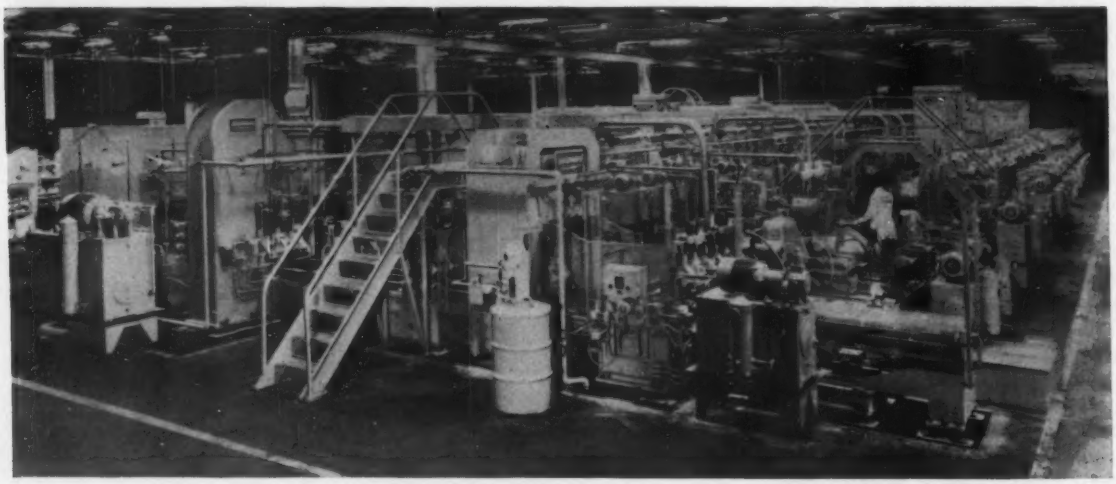


Fig. 1. Buhr seventy-six-station Economatic, installed at plant of Saginaw Steering Gear Division, General Motors Corporation, for finishing power-steering pump housing

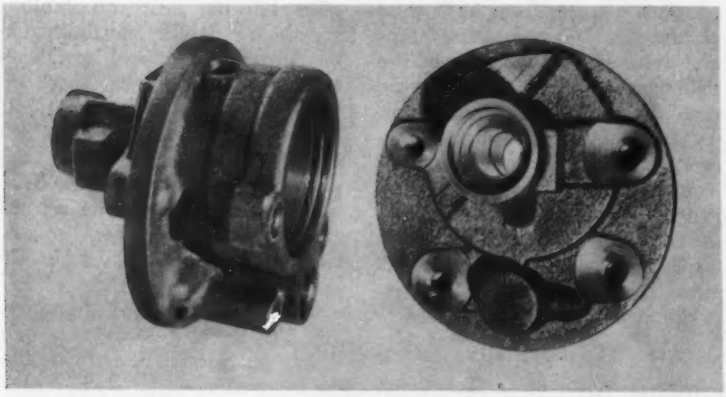


Fig. 2. Two views of the Saginaw power-steering pump housing processed on machine shown in Fig. 1 with the finished part at the right

of the appropriate color—any one of three—to indicate the relation of the gage reading to the specified tolerance range. At light-machining stations, work-pieces are flooded with soluble-oil coolant to remove chips. After leaving the last machining station, parts are run through an air-blow booth to remove chips remaining in deep holes and on the fixture. Just before the palletized fixtures are indexed to the unload station, the fixture clamp is automatically backed off and rotated 90 degrees so the operator can easily unload the parts.

Transfers of this type are versatile because different types of operations can be combined in them and because they can be rearranged to profit from experience gained during production runs. This is especially true when standard units are used, as in this Economatic. During tryout of this machine, for example, it was found that the critical pump-body face was produced to the close print tolerances for flatness by the single-point, surface-generating tool. There was no need for a subsequent burnishing operation originally included in the process. Thus, the burnishing operation has been dropped, and after shifting units and operations at two other stations, it has been possible to add a new operation, one that was to have been done as a secondary operation. The added operation is for ballizing a hole to size and to give it the exceptionally fine surface finish required.

Another example of the versatility of this Economatic is found at the face-milling station. The face mill is hydraulically fed in to the pump housing and mills on an upward feed stroke of the cutter. Change gears have been included in these heads so that the proper feed and cutting speed may be paired for optimum cutter life. The ability to vary the spindle speed provides flexibility for work-piece material changes in the future. The precision-boring operations require almost twice as much time as any other operation on this twenty-four-second cycle machine. Rather than double the cycle time, pallets are accumulated, then indexed two at a time

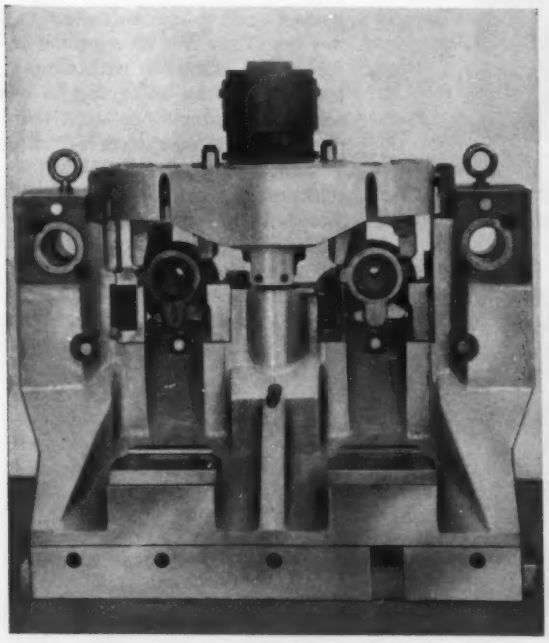


Fig. 3. Front view of the palletized fixture of machine shown in Fig. 1 with two housings clamped in position

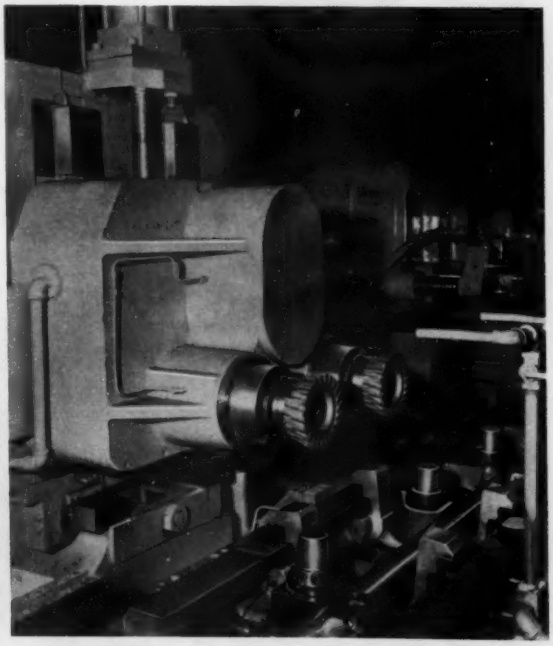


Fig. 4. Face-milling head of Buhr Economatic, Fig. 1, which is hydraulically fed in to the work-pieces

through the two boring stations.

Automatic in-process checking is done at various stations by twelve probes, to make certain that holes have been drilled, and thirteen drill checks made to monitor the condition of other drills. In addition to automatic classification, roving inspectors occasionally check partially finished work-pieces when the pallet fixtures are in idle stations. With dial-indicator gages, they can check a housing from both sides of the line. Gage-locating steps and buttons are included in the palletized fixture to reduce the time required for these inspections. As a safety measure, however, the inspector actuates a selector switch at the station to prevent the operator from indexing the transfer mechanism. When the inspector has checked the work-piece, he shifts the selector switch so the machine can cycle again.

Gaging Modules for "Do-It-Yourself" Instrumentation

The Radio Corporation of America, Industrial and Automation Division, Detroit, Mich., is now offering a complete line of standard electronic modules which can be easily assembled into semi-automatic or completely automatic high-speed inspection systems for simple or complex dimensional measurements. Production-proved, these modules are in wide use throughout the metalworking industry in various applications such as automatic hardness testing, self-compensating grinder controls, valve and spring testing, as well as in the inspection of ball and roller bearings, pistons and piston pins, and crankshafts.

Systems built with these modules offer 100 per cent repeatability, very high reliability, flexibility, immediate response, and accuracies to millionths of an inch. There are five basic units: (1) the AGMC master-gage control, Fig. 1, which includes a gage head and is the primary building block of the RCA system. It transforms the electrical changes caused by the displacement of the gage tip into a directly usable signal requiring no amplification; (2) the ATM thyratron unit, Fig. 2, is the electronic switch which provides a directly usable limit signal; (3) the APS power supply, Fig. 3, which is a standard unit, only one of which is required with up to five thyratrons; (4) the DC-7 difference computer, Fig. 4, which subtracts measurements from two AGMC units, provides a reject signal and is used for calculating taper, parallelism, squareness, and similar dimensional characteristics; and (5) the SC-7 sum computer, not shown, which adds the signals from two AGMC units and is used to calculate over-all dimensions determined by the individual measurement of two segments of the over-all dimension.

Fig. 1. AGMC master-gage control unit of RCA electronic gaging system

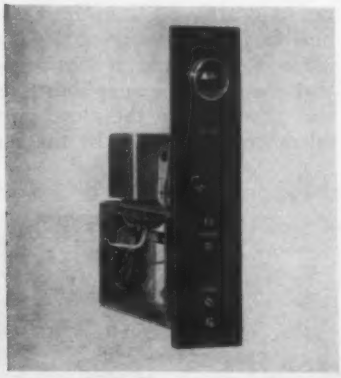


Fig. 2. ATM thyratron unit of RCA's line of standard electronic modules

Fig. 3. APS power-supply unit of RCA "do-it-yourself" inspection system

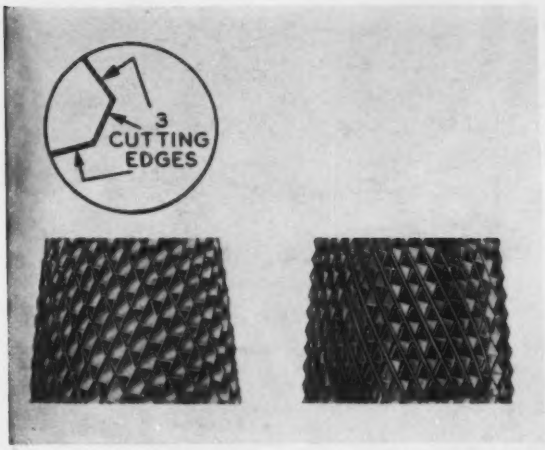
Fig. 4. DC-7 difference computer for RCA electronic gaging system

These building-block units can be used in a number of different combinations to solve even the most complex measurement problems, as well as to actuate segregating, marking, and stamping devices. They can be supplied individually, complete with connector for plugs for mounting in the customer's cabinet, or as a completely integrated system including a wiring harness and cabinet. A selection of nine gage heads with sensitivities that provide full scale readings of 0.005 to 0.020 inch are available with the GMC unit. A typical system for measuring a single dimension consists of an AGMC module, two thyratrons, and a power supply. Its over-all dimensions would be 16 inches long by 9 3/4 inches wide by 8 3/8 inches high.

Circle Item 572 on inquiry card

Atrax "Dia-Mo"-Cut Burrs

A type cut for burrs has been designed, production-tested, and introduced by the Atrax Co., Newington, Conn. Called "Dia-Mo" cut, it has many advantages over the ordinary diamond cut



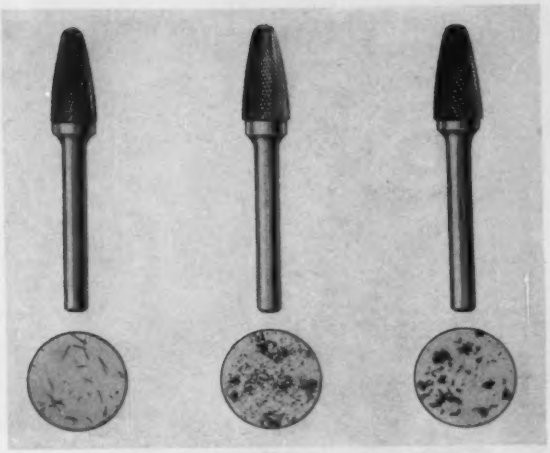


Fig. 1. (Left) Atrax "Dia-Mo"-cut developed for burrs. (Right) Conventional diamond-cut burr. Fig. 2. (Left) Standard-cut burr with chips. (Center) Diamond-cut burr with chips. (Right) Atrax "Dia-Mo"-cut burr with chips

previously furnished in that it provides a tooth form with three cutting edges, as illustrated in the views to the left, Fig. 1. By carefully controlling the depths to which both the left- and right-hand flutes are cut and maintaining a definite ratio between them, a three-sided tooth formation results, instead of the pyramidal type tooth form obtained with the conventional diamond-cut pattern shown to the right in Fig. 1.

Dia-Mo-cut burrs are said to have all the advantages of the old diamond-cut burrs plus longer tool life. It is claimed that the Dia-Mo cut practically eliminates "burr climb," increases cutting action and stock removal, and reduces operator fatigue. The new cut design is especially adaptable for burring heat-treated, alloy, and stainless steels. Its shearing action produces a fine flake type chip, instead of the long sliver type chip formed by burrs with conventional type cuts.

It is recommended that the new burrs be operated at 1/3 to 1/2 the speed of conventional-cut burrs for best results and for smooth, uniform surfaces that will facilitate subsequent grinding or polishing operations. The Dia-Mo cut is available upon request in 615 different burr sizes and types in standard, fine, and coarse cuts.

Circle Item 573 on inquiry card

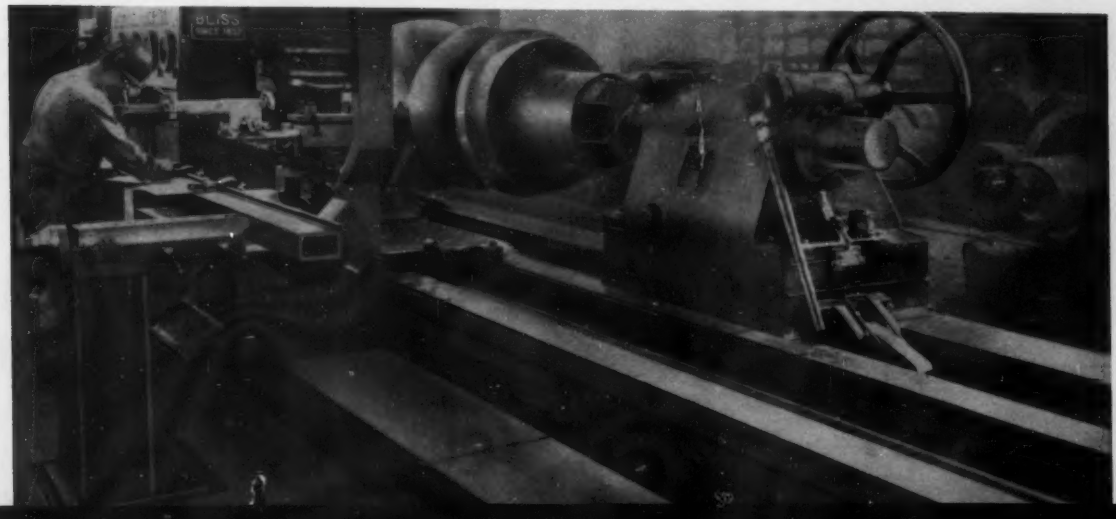
Automatic Contouring Lathe

A 48-inch, automatic roll lathe built by the Mackintosh-Hemphill Division of the E. W. Bliss Co., Pittsburgh, Pa., was recently placed in operation in the roll shop of a large eastern steel producer. Fitted with electronic tracing equipment, it automatically cuts contours in structural and shape rolls up to 4 feet in diameter and 21 feet long, turning either on centers or roll neck housings as required.

When cutting shape work, the lathe can make 8-inch plunge cuts. It is used for both roughing and finishing work on a round-the-clock basis. Special features of this lathe include an all-geared, totally enclosed headstock, an extra-wide three-way bed, carriage rapid traverse, and a live-center tailstock.

Circle Item 574 on inquiry card

Mackintosh-Hemphill automatic contouring or roll-turning lathe



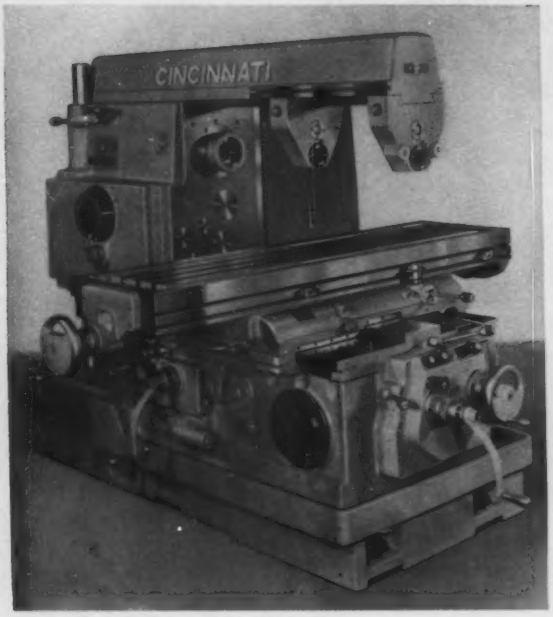


Fig. 1. Cincinnati general-purpose milling machine which combines advantages of three types

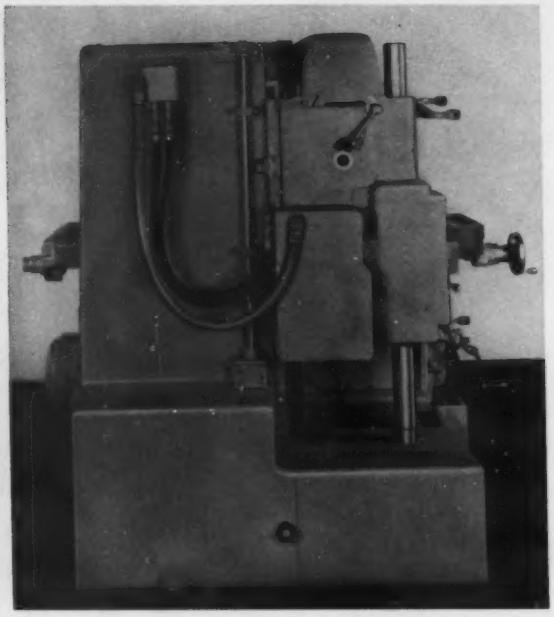


Fig. 2. Rear view of machine, Fig. 1, combining features of bed, knee and column, and rise-and-fall types

Advantages of Three Types of Milling Machines Combined in One Model

The rigidity of bed type, the convenience of knee and column type, and the capacity of rise-and-fall type milling machines are combined in the latest fixed-knee milling machine introduced by the Cincinnati Milling Machine Co., Cincinnati, Ohio. The unique design of this equipment, which eliminates the knee and transfers vertical motion to the spindle carrier, is said to give it unusual advantages which make it an exceptional general-purpose mill. The saddle and table are mounted directly on the machine bed—there is no knee. The square gibbed ways on which table and saddle slide are exceptionally wide. This low, broad-based design makes the machine especially adapted to heavy cuts, climb as well as conventional milling, and the handling of large, heavy work-pieces.

The pattern of sturdiness is continued in the headstock with its broad vertical way on which the spindle carrier rises and falls. Rise-and-fall movement is transmitted vertically through a screw which also serves as a secondary point of suspension for the spindle carrier. The arbor rotates in supports mounted on the familiar Cincinnati Dynapoise over-arm, with its vibration-damping characteristics. Fast changing of cutting tools is assured by the Arbor-Loc spindle nose on the face of the spindle carrier.

Two full sets of controls are provided—a front set and a similar set on the side of the base behind the saddle. The operator can use either set if his view of the cutting action is blocked by the workpiece. Controls include push-button, power speed selection, power feed selection through knobs, and hand controls for longitudinal, cross, and vertical movements.

Feed rates (32 in geometric progression) and speed rates (24 in geometric progression) can be read at a glance on large dials near the operating stations. All drive motors and a full cutting fluid system are standard equipment. The new milling machine can handle reciprocating, box milling, and climb cuts with ease. An automatic backlash eliminator serves to prevent chatter and assure smooth cuts. Backlash is prevented by two counter-rotating, gear-driven nuts on the table feed-screw. The backlash eliminator does not operate during rapid traverse.

The operator has the option of cycling the table manually or automatically. Trip dogs mounted in T-slots on the front of the table actuate the automatic cycles. This fixed-knee machine is currently available in four models ranging from 20 to 30 hp, with 72 to 80-inch table travel, 12-inch saddle travel, and 20-inch vertical travel. Standard options and accessories are the same as those regularly available for the manufacturer's Dual Power line.

Circle Item 575 on inquiry card

Electric-Hydraulic Presses

Two motor-operated hydraulic presses, built for tough, heavy-duty jobs requiring pressures of 60 and 80 tons, respectively, have been introduced by the Equipment Division, American Chain & Cable Co., Inc., York, Pa. Complementing their recently announced 150-ton electric-hydraulic press, these versatile low-cost units have been designed to meet the wide variety of pressroom needs in machine shops,

factories, railroad repair depots, rolling mills, maintenance shops, etc. Frame members of these high-capacity presses are fabricated from selected structural steels and their rams are ground to obtain a fine 16-micro-inch finish.

The units are provided with completely enclosed hydraulic systems which prevent fluid contamination. They are equipped with easily removed, fine-mesh screens to filter the oil supply. All fittings and connections are designed to contain the high pressures developed during work cycles. Their work-tables are also fabricated from structural steels and can be moved through a wide range of travel by an easily operated worm-gear reduction winch. This winch is self-locking and has a sealed and lubricated gear-train system for greater safety.

The entire hydraulic work-head on the 60-ton press is mounted on ball-bearing wheels and can be moved by finger pressure to any desired work position. Easy and fast contact between the ram and work is made possible on both units by rotating a handwheel geared to an Acme-thread, ram-extension screw. It permits rapid approach to the work, makes contact for proper positioning, and reserves the full power stroke for the work to be performed.

Equipped with many safety features, its bypass valve, which is set at the factory, prevents any possibility of the operator overloading or damaging the press. Its ram-travel control mechanically moves the control-valve lever to neutral when the ram has reached the maximum travel. A Helicoid pressure gage instantaneously records pressures during every moment of operation and shows the operator when the full capacity of the press is being reached.

Electrical operating controls for each unit are placed in a conveniently located switch box. Control is furnished by a three-position valve that will automatically return to neutral from either the ram advance or retract position. The "power package" for each press is rated at 25 per cent duty cycle at full load and 50 per cent duty cycle at 3/4 load.

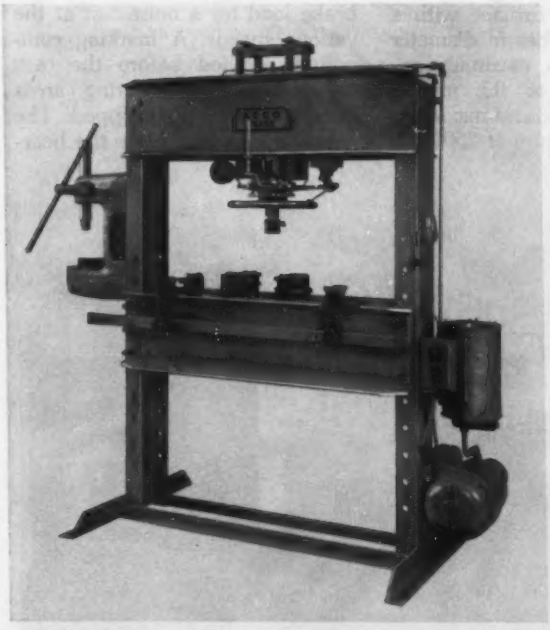
Finished in machine gray, both units are available in two models, powered by a 2- or 5-hp motor, for different operating characteristics. For example, the Model MHP-60-E22, of 60-ton capacity, when equipped with a 2-hp motor, has a ram speed of 10 ipm (inches per minute) at no load and 6 ipm at capacity. The Model HP-80-E55, of 80-ton capacity, equipped with a 5-hp motor, has a ram speed of 25 ipm at no load and 15 ipm at full load.

Circle Item 576 on inquiry card

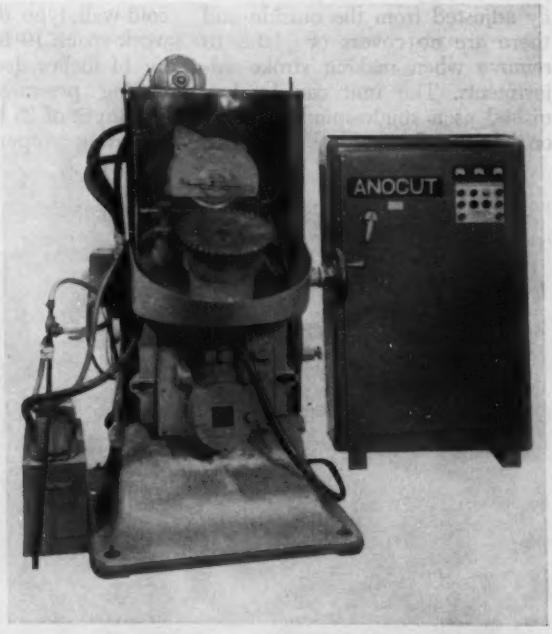
Face-Mill Grinder Employing Electrolytic Process

The electrolytic grinding process has been applied to an automatic face-mill grinder recently announced by Oliver Instrument Co., Adrian, Mich. This combination is said to produce substantial savings in diamond-wheel costs and cutter life, while improving work-piece finish due to the face radius and reduced grinding run-out on the face mill. It is also claimed that the electrolytic grinding process eliminates carbide-insert cracking and checking normally experienced with conventional grinding methods.

In a completely automatic cycle the machine grinds the lead angle,



Electric-hydraulic press of 80-ton capacity equipped with a 3-ton arbor press and test centers announced by the Equipment Division of American Chain & Cable Co., Inc.



Oliver automatic face-mill grinder which employs electrolytic process in grinding the lead angle, corner radius, face radius, dish, and soft-steel backing of face-mill teeth

corner radius, face radius, dish, and soft-steel backing of inserted teeth. Tooth shape is controlled by a simple cam arrangement. The machine cycle time on a given tooth averages twenty-nine seconds, producing an 8-micro-inch finish (approximately).

Four machine sizes accommodate face mills from 4 to 21 inches in diameter. The faceplate which holds the cutter indexes automatically and can be set for eight or more teeth. The machine operates hydraulically and utilizes a 300-ampere Anocut electrolytic unit or its equivalent. Machine setup time for various cutters takes approximately five to ten minutes.

Circle Item 577 on inquiry card

Hydraulic Self-Contained Quill Type Unit

A self-contained hydraulic unit of the quill type, incorporating standard hydraulic valves, pump, and switches for power and control of feeds, is being introduced by the Rehnberg-Jacobson Mfg. Co., Rockford, Ill. Push-button control starts the timing belt-driven spindle and variable-volume pump of this unit. Speeds are varied by changing the timing belts and sheaves. All control dogs are readily adjusted from the outside and there are no covers or plates to remove when making stroke adjustments. The unit can be furnished as a single-spindle model, or the front flange can be used for mounting on a multiple-spindle head. The spindle and ram are arranged in direct line (coaxial) for maximum thrust efficiency.

The unit can be mounted in any position and the motor can be located either on or off the unit. All oil passages are drilled and the cylinder bore is precisely honed. Valves are all sub-plate mounted and there are no outside pipe connections. The hydraulic feed valve is of the sensitive compensating type. No relief valve is required since the unit employs a variable-volume type of pump.

The unit has a stroke range of 0 to 8 inches and a thrust capacity of 3500 pounds at a hydraulic operating pressure of 750 psi. The feed rate is 0.2 inch to 40 ipm (inches per minute). Rapid approach and return rate is 240 ipm. A 3-hp motor operating at 1800 rpm is used for spindle speeds of 600 to 2500 rpm; a 3-hp, 1200-rpm motor for spindle speeds of 250 to 2500 rpm; and a 5-hp, 1800-rpm motor for speeds of 600 to 2500 rpm. Drilling capacity in cast iron is 1 1/4 inches and 1 inch in steel.

Circle Item 578 on inquiry card

Ipsen Heat-Treating Unit

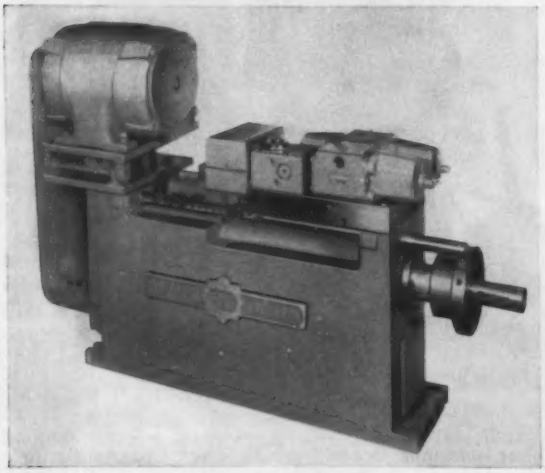
A new automatic, high-vacuum, cold-wall type of furnace with a work space 10 inches in diameter by 14 inches deep, maximum operating pressure of 0.1 micron Hg, input of 25 kw, and maximum operating temperature of 2500 degrees F. is announced by Ipsen Industries, Inc., Rockford, Ill. This versatile, vacuum heat-treating unit with forced cooling is adaptable for high-temperature copper or nickel brazing of stainless-steel assemblies. Other applications of this compact laboratory-size unit include: vacuum annealing, special tool-steel hardening, tempering, and drawing of refractory metals, reactive metals, and stainless and special-alloy steels.

Circle Item 579 on inquiry card

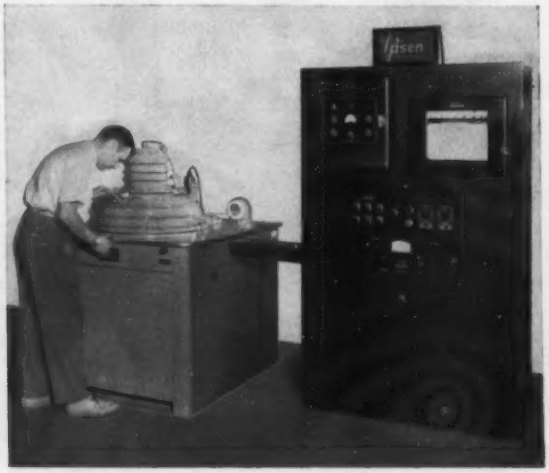
Gleason Hypoid Gear-Testing Machine

A variable-speed bevel and hypoid gear-testing machine which can test gears up to 36 inches in diameter and of any shaft angle from 10 to 130 degrees has been brought out by the Gleason Works, Rochester, N. Y. Besides testing for location of tooth bearing area, this Gleason No. 138 hypoid gear tester can check for quiet operation at any speed from 200 to 2000 rpm and during acceleration and deceleration.

The pair of gears to be tested is mounted in the machine with the proper backlash. The gears are then run together under a light brake load for a noise test at the various speeds. A marking compound, applied before the test, shows the tooth bearing areas after the gears are stopped. The operator can then place the bear-



Rehnberg-Jacobson hydraulic self-contained quill type unit



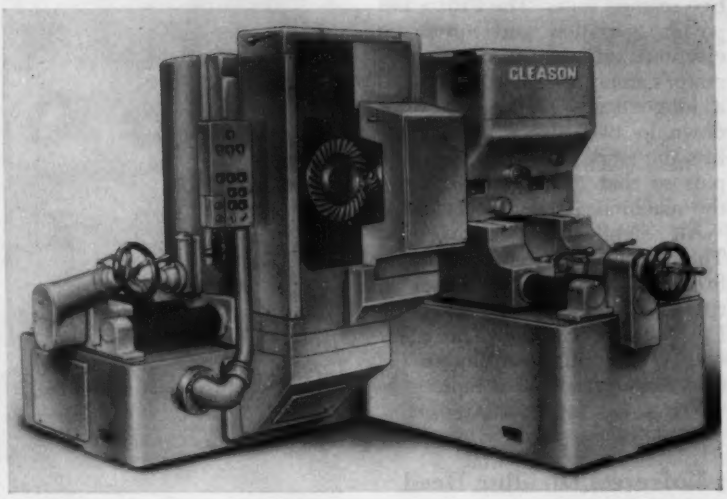
Heat-treating unit announced by Ipsen Industries, Inc.

ing in the proper position and determine the corrections necessary in the gear-cutting equipment.

The gears can also be run together without backlash. In this "slow-roll" test, a light spring tension holds the gears in metal-to-metal contact, and a dial indicator shows the composite error in run-out and tooth spacing.

Design features include an automatic backlash mechanism which establishes the correct lash for each pair of gears regardless of the dimensional differences between them. The high-precision spindle bearings are installed with an initial pre-load to eliminate deflections. The pinion head is withdrawn to permit changing work.

Circle Item 580 on inquiry card



Hypoid gear-testing machine brought out by the Gleason Works

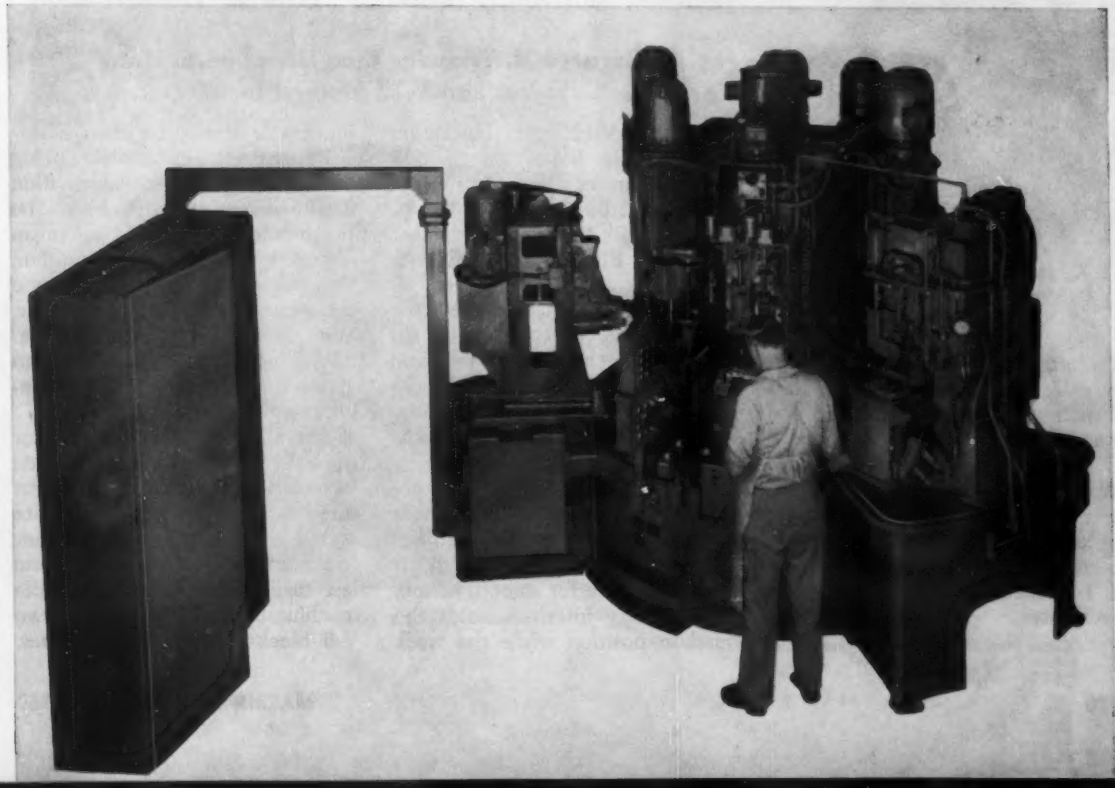
Kingsbury Automatic Machine for Processing Aluminum Valve Bodies Used in Automatic Transmissions

A multiple-unit automatic machine which has the center column equipped for processing aluminum valve bodies used in automatic transmissions has been built by the Kingsbury Machine Tool Corporation, Keene, N. H. Eight units with twenty-two spindles perform operations at a gross rate of 370 parts per hour to qualify them for an in-line machine. A 60-inch index-table holds ten work fixtures equipped for power clamping and automatic unclamping. A separate fixture at the operator's right holds the work for a separate milling operation.

In both styles of fixtures the joint face of the valve body is down and is used for the locating surface. In the indexing fixtures rotative location is accomplished with a hole and a pocket arrangement. Double-ram plungers operate a cam that actuates two clamps to hold the work down. An air cylinder unclamps each of these fixtures.

In the single fixture, accurate rotative location is assured by

Machine built by Kingsbury Machine Tool Corporation for processing automatic-transmission part



two reamed holes. The fixture has power operation and automatic ejection designed to save the operator's time. An air cylinder with a long stroke clamps the work down in two places. An ejector lifts the work off the two locating pins so that it slides away from the machine. (Chute not shown.)

All eight units are vertical. Three of them (one at the separate fixture) mill-faces with motorized spindles at 3500 or 7200 rpm. Five units operate on the holes with eight drills, two butt mills, four reamers, and five taps.

Circle Item 581 on inquiry card

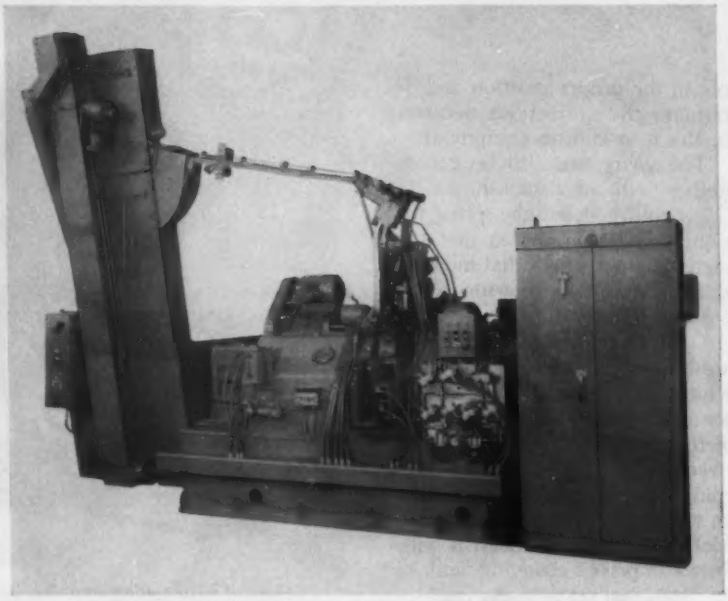
Universal Dividing Head

A 10-inch Model E universal dividing head is announced by the Nichols-Morris Corporation, White Plains, N. Y., as a companion to its present line of 6 1/2-inch Model A and 8-inch Model C precision dividing heads. The Model E is a trunnion type designed for heavy-duty applications. It has an indexing accuracy of 1 minute in 360 degrees, auxiliary swivel base (optional) providing 360-degree swiveling in the longitudinal plane, compound indexing as well as direct and crank indexing to provide a wider range of divisions, and 2-inch riser blocks (optional) for headstock and tailstock.

Nichols-Morris universal dividing head

Provision is made for quick worm disengagement to permit direct indexing. Accessories available include draw-in collet attachment for No. 5C collets up to 1 1/16-inch capacity, chucks, and faceplates.

Circle Item 582 on inquiry card



Davis & Thompson horizontal index machine for processing ball studs

Horizontal Index Machine with Hopper Feed

A Type HT six-station, horizontal index machine with hopper feed arranged to drill and chamfer cotter-pin holes and mill screwdriver slots in a variety of sizes and types of ball studs is announced by Davis & Thompson Co., Milwaukee, Wis. Two workpieces are fed into a fixture at each indexing movement of the machine.

The sequence of operations performed automatically consists of: load at Station 1; countersink two pieces from both sides at Station 2; drill approximately half way through from both sides at Station 3; drill through both pieces from one side and mill screwdriver slot in end of piece at Station 4; probe to insure completion of hole at Station 5; and automatically eject work at Station 6. Clamping is automatic at each work station.

Circle Item 583 on inquiry card

BarnesdriL Transfer Line Designed to Hone V-6 and V-12 Motor Blocks

V-6 and V-12 motor blocks are automatically honed on a new honing transfer line, Fig. 1, designed by the Barnes Drill Co., Rockford, Ill. Vertical type honing machines, Fig. 2, are used with fixtures designed to tilt the V-shaped motor block so that the bore is in a vertical position for honing. One six-spindle machine is designed to hone two V-6 blocks at one time and a three-spindle machine hones the V-12 block. The two units do not operate simultaneously. Immediate changeover from V-6 to V-12 honing takes place as production requires. Both units are equipped with air counterbalance for smooth action, and a safety interlock holds the head in position while the work indexes or stones are changed.

BarnesdriL Plugmatic sizing maintains size consistency within 0.0003 inch from bore to bore. The pneumatic hone-feed mechanism is equipped for rapid expansion, rapid collapse, and automatic compensation for stone wear. With stock removal of 0.002 to 0.0035 inch, finish is held at 15 to 25 micro-inches. Previous machining consists of fine boring.

The three-spindle machine for the V-12 block is designed to hone three bores, index to hone the next three bores, automatically rotate and hone three bores, and index to the original position to hone the last three bores. The six-spindle machine hones three bores in two V-6 blocks at one time, rotates,

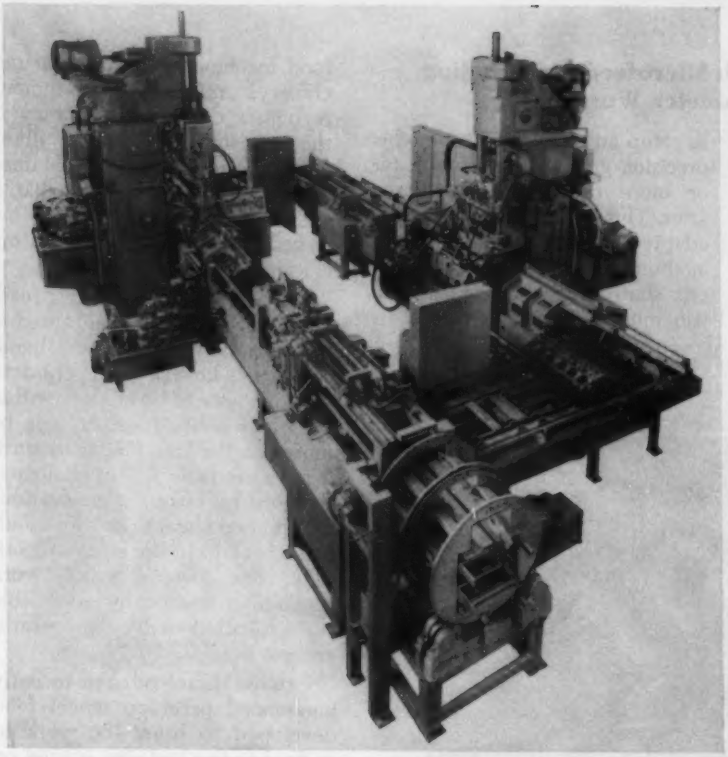


Fig. 1. Transfer type honing machine for V-6 and V-12 motor blocks designed by Barnes Drill Co.

and hones the remaining three bores in each block. A roll fixture rotates the blocks to remove surplus coolant.

Circle Item 584 on inquiry card

Motorized Hardness Tester

A hardness tester which automatically removes major testing loads from the work-piece has been announced by the Torsion Balance Co., Clifton, N. J. Known as the "Motorized Kentrall," it eliminates much of the effect of operator technique. It also gives uniform test results and reduces operator fatigue. This instrument is available as a combination tester which provides for both regular and superficial Rockwell hardness testing in a single machine. For those applications that do not require the additional range, the "Motorized Kentrall" is also available as a single-purpose tester for either regular or superficial testing.

Circle Item 585 on inquiry card

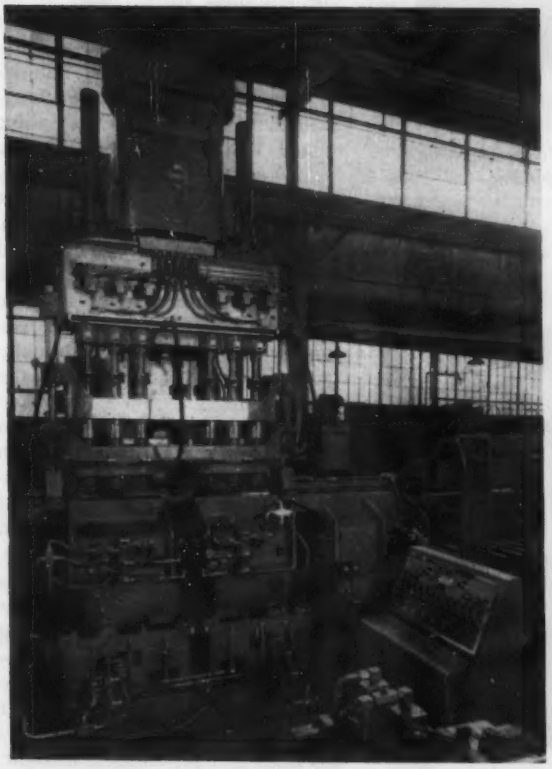
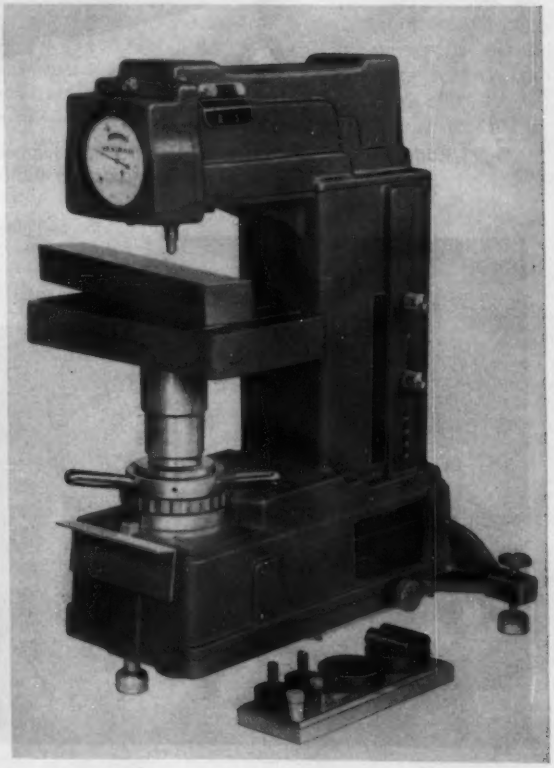


Fig. 2. Close-up of Barnesdril honing machine incorporated in transfer line shown in Fig. 1



"Motorized Kentrall" hardness tester for regular or superficial tests announced by Torsion Balance Co.

Landis "Size Finder" with Microfeed for Grinding Multiple-Diameter Work

Significant savings in grinding costs are being made by grinding machines equipped with newly developed "Size Finders," both products of the Landis Tool Co., Waynesboro, Pa. The Size Finder, an exclusive Landis development, is said to make substantial savings in setup and operating time when precision grinding shafts with two or more diameters of different sizes. This equipment is especially adapted for grinding small to medium-size lots of multiple-diameter shafts for machine tools, electric motors, pumps, compressors, food machinery, construction machinery, and similar equipment. A higher degree of accuracy in the concentricity between diameters is also said to be obtained when using this equipment than is possible where work-pieces are racked or rechucked between operations.

Fig. 1. Landis plain hydraulic grinding machine equipped with "Size Finder" visual sizing gage for multiple-diameter shaft grinding

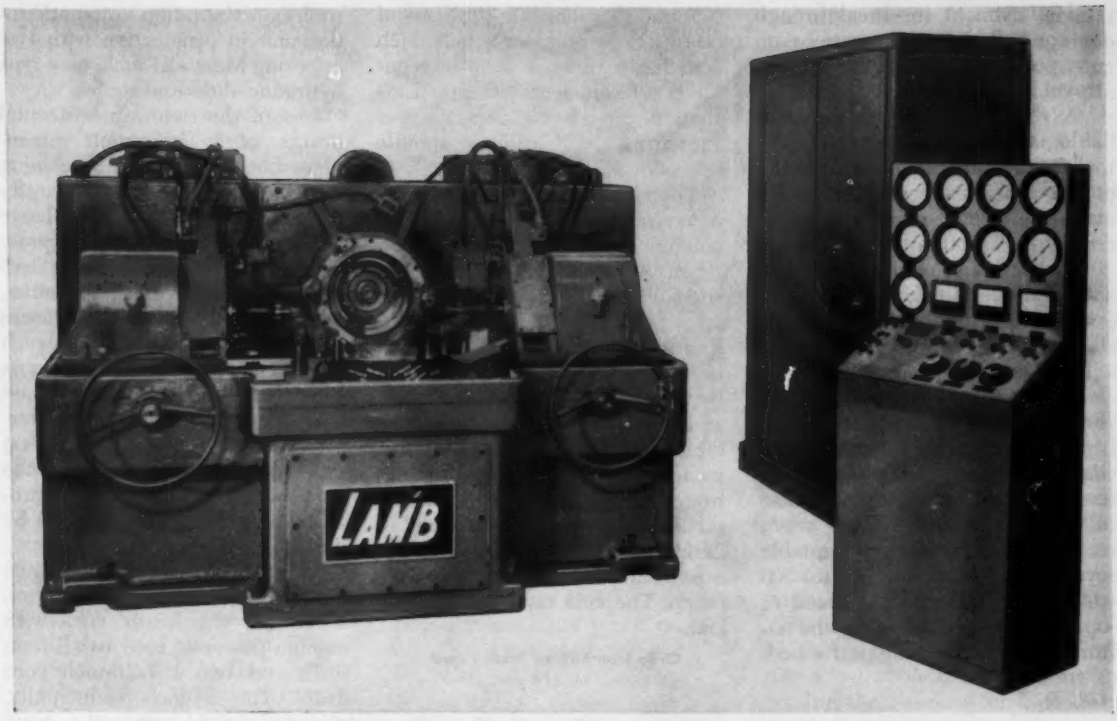
Fig. 2. Close-up of push-button control station with signal lights and direct-reading indicator of Landis "Size Finder" with Microfeed

The Size Finder is a direct-reading counter which is calibrated to the grinding-wheel-feed handwheel on new Landis grinders. Any diameter to be ground, within the range of the machine, can be dialed on the Size Finder by turning the handwheel. This eliminates the need for counting graduations of the handwheel to set the grinding wheel head to a given position. The possibility of work spoilage is practically impossible since calculations by the operator are not needed.

Landis Microfeed, the recently announced precision wheel feed developed to bring the work to its final or finished size, is used on Size Finder machines to automatically cancel all grinding-feed variables. The Microfeed advances the grinding wheel head in 50-millionths-inch increments after spark-out to finish size as indicated by the sizing gage. The operation is simple, even for semi-skilled operators. The grinding wheel is first calibrated to the Size Finder by dressing. Sizing gages are set for each diameter to be ground. From this point on, the operator turns the wheel-feed handwheel until the finish dimension to be ground appears on the face of the Size Finder. The operator initiates the automatic grinding cycle and applies the preset sizing gage for the particular diameter being ground. When the indicator shows that the finish size has been reached, the operator retracts the wheel head, thus completing the cycle which is then repeated on the next work-piece.

For diameters of shaft sections not covered by the width of the wheel, a series of overlapping plunge grinds is taken to bring the work to within a few tenths of the finish size. A final traverse pass, at finish size, then removes all overlap lines and produces a straight, smooth finish.

Circle Item 586 on inquiry card



Test stand for automotive transmissions announced by F. Jos. Lamb Co.

Final Test Stand for Automotive Transmissions

The F. Jos. Lamb Co., Detroit, Mich., has designed and built a final test stand for automobile transmissions that simulates the most severe conditions under which such transmissions will be used. The new unit checks all ranges at varying speeds and reverse, with and without loads. Transmissions to be tested are manually rough-positioned in the test stand. Final positioning and clamping operations are performed automatically.

The unit operates from a central-transmission oil supply but can be arranged with an individual oil reservoir. A variable direct-current reversible motor drives the transmission. Two output shafts simulate the rear axles. Either axle can be locked out to duplicate one-wheel spin or one-wheel overload. A liquid-cooled, electric-eddy-current brake is used to produce rear-axle load conditions. The complete test cycle, floor to floor, takes approximately six minutes.

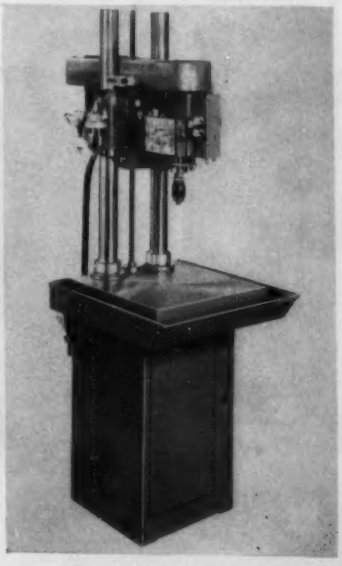
The test machine is controlled from the console that permits selection of speed range. Tachometers indicate input and output speed. The speed differential shows power-transmission efficiency under load and no-load conditions. Other gages show vacuum and oil pressure.

Circle Item 587 on inquiry card

Vertical Drilling Machine

A single-spindle, vertical drilling machine with a full range of automatic controls to handle the large variety of second-operation drilling, tapping, countersinking, facing, reaming, hollow milling, or threading operations on screw-machine parts, die castings, stampings, headed or plastic parts has just been announced by the Universal-Automatic Corporation, Schiller Park, Ill. The capacity of this unit includes 0.020- to 3/8-inch drilling in mild steel and up to 3/8-inch tapping and 1/2-inch threading.

A 3/4-hp spindle motor and drive pulleys provide a speed range of from 500 to 10,000 rpm. An adjustable spindle feed is obtained with compressed air through a 2 1/2-inch maximum stroke length by means of intake and exhaust metering screws for both top and bottom of the tandem piston-rod assemblies. This is supplemented by hydraulic con-



Universal-Automatic drilling machine with automatic controls

trol adjustment for breakthrough or controlled feed operations on any portion of 2 inches of spindle travel.

A dwell unit provides adjustable pause at the top of the stroke when the unit is operated automatically. This permits time for manual loading or positioning, as desired. A bottom dwell control furnishes additional control for fine surface finishing and holds repeatable depth limits within 0.0005 inch.

An electrical circuit combining a solenoid-actuated valve and limit switch synchronizes spindle operation with any feasible clamping, positioning, indexing, or escapement mechanisms, and also allows manual control for setup or test runs. Infinitely variable cycle control ranges up to 500 strokes per minute. The speed of operation is determined by the nature of the work being performed. Normal shop-line air pressure of 80 to 100 pounds per square inch is reduced through built-in regulators to suit requirements. Less than 5 pounds air pressure per square inch will maintain spindle operation.

The spindle unit is mounted on heavy, accurately ground double columns and the entire unit can be easily raised or lowered to desired height by means of a center screw adjustment. Distance from spindle nose to table work surface is from 0 to 24 inches. Clearance between center line of spindles and columns is 8 1/2 inches. The table work surface is 18 by 18 inches. Simple chip and oil return trough are provided. An auxiliary surface wear plate is available, if desired. The base cabinet contains a removable coolant drawer and pump. The tank capacity is 6 gallons.

Circle Item 588 on inquiry card

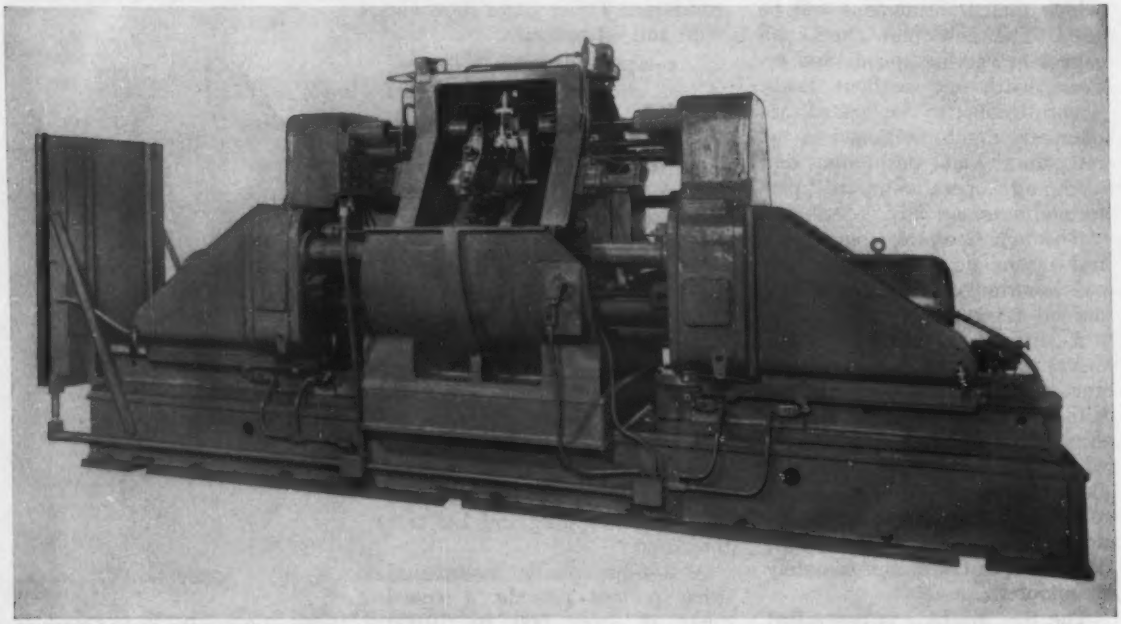
Six-Station, Two-Way Trunnion Type Machine for Processing Flange Yokes

With increased production rates made possible by processing two parts in each fixture, a Model 2-HWT-240 machine manufactured by the Morris Machine Tool Co., Cincinnati, Ohio, automatically drills, bores, and mills a pair of holes in 158 steel forgings per hour. This two-way, heavy-duty, revolving trunnion type machine utilizes a six-station automatic index unit in conjunction with two opposing Morris 24-inch, way type hydraulic slide units.

Use of the two-way horizontal design offers important advantages both in terms of machining efficiency and the large quantity of chips involved. The flange yokes for universal joints processed on this machine have two bosses, opposed to one another, with holes 1.535 to 1.530 inches in diameter to be completed in each boss. The two-way operation is such that the drilling pressure on one side of the part is counteracted by the drilling pressure on the other side. In this way, the part rather than the fixture absorbs most of the force exerted by the drills.

Although the loading of two parts at a time doubles output, it requires two heads, each with enough power to feed two 1-inch drills and two 1 7/16-inch core drills. The 24-inch slide units, mounted on 24-inch ways, have an ample thrust capacity of 14,700 pounds. Each unit operates independently and at a constant feed, regardless of the respective conditions of the tools. Ten spindles are mounted in each head.

Circle Item 589 on inquiry card



Morris six-station, two-way trunnion type machine equipped to process automotive part

Kennametal Solid-Carbide Fluted Tools

An extensive line of solid-carbide fluted tools, including burrs, internal grinding tools, boring tools, reamers, drills, and routers, has been announced by Kennametal Inc., Latrobe, Pa. Burrs of forty-six shapes made in sizes up to 1/2 inch in diameter are available with six types of cutting surfaces. Internal grinding tools include seventeen sizes up to 3/8 inch in diameter. Boring tools are made in ten sizes from 0.090- to 0.360-inch minimum hole diameter. Reamers with straight, right- and left-hand spiral flutes are within the size range of 1/16 to 3/8 inch in diameter. Flat drills range from 3/32 to 1/2 inch in diameter. Drill and countersink combinations range from 1/8 to 1/2 inch in diameter. Standard spiral drills are made in 1/64-inch steps from 1/16 to 1/2 inch in diameter, and in sixty wire-gage sizes. Routers include profiling single-flute series and two-flute straight router mills.

Circle Item 590 on inquiry card

Retractable Work Chute for Automatics

A retractable work chute, designed to catch finished workpieces as they are cut off on 2AB single-spindle bar automatics, has been developed by the Warner & Swasey Co., Cleveland, Ohio. Powered by the machine's standard hydraulic system and operating independently of the pentagon turret, this work chute transfers each completed piece to a bin or other receptacle. The chute automatically moves into position between the 2AB cross-slides at the proper time to catch the cutoff part, then retracts to avoid any interference with subsequent machine functions.

The new chute is of particular value in the machining of work requiring close tolerances or high-quality surface finishes, since it prevents contact or impact between the work-piece and the machine's structure or operating elements following cutoff. Once installed, its use is optional and no special setup is required for the chute's operation on a particular job. The retractable work chute also can be used for single-station operation, again moving into position automatically when the cutoff slide is actuated.

Warner & Swasey retractable work chute applied to automatic

Circle Item 591 on inquiry card

Gear-Rolling Fixtures for Checking Internal Gears

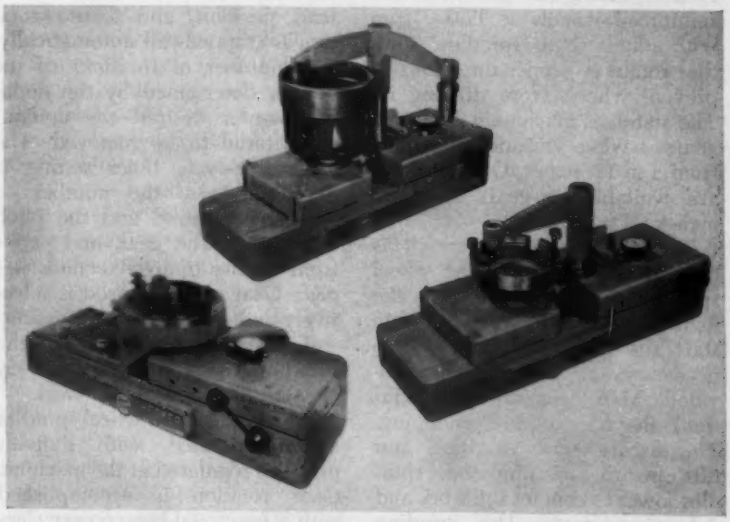
A line of Red Ring Model GRB gear-rolling fixtures that have been especially adapted to the checking of internal spur or helical gears is now available from National Broach & Machine Co., Detroit, Mich. The fixtures have a 27-inch long by 8 3/4-inch wide cast-iron base. The movable slide unit at the right carries the master-gear mounting and the indicator which shows center-distance variation resulting from any errors in the gear being checked. This slide is spring-loaded and travels on ball bearings. A hand lever at the front moves the slide in opposition to the spring loading to permit engagement of the master gear with the work gear.

The gear to be checked is mounted on a fixed base at the left. These fixtures can be of different designs as shown to enable the checking of gear-tooth accuracies in relation to desired gear dimensions. When the internal gear is of such a design that the master gear cannot be entered from the bottom, the master gear is supported on an arm unit on a post as shown in the gages at the top and at the right in the illustration.

The gage shown at the top of the illustration has two arms to enable the checking of both gear tooth runout and minor diameter runout with the same gage. One arm carries a master gear and the other, a relieved, flat gage unit.

Zero settings for the gage indicator are made by using gage-blocks to set proper center distance between master gear and work gear. The indicator finger engages a stop on a fixed arm mounted on the rear of the gage.

Circle Item 592 on inquiry card



Three Red Ring rolling fixtures for checking internal spur or helical gears

Fig. 1. Michigan Tool Co.'s grinder for spur, helical, and bevel-ring gears deburrs and chamfers the entire contour of both ends of teeth simultaneously

Fig. 2. In working position, with hood removed, grinding wheels of machine, Fig. 1, rise and fall to follow contour of heel and toe sections of bevel-gear teeth

Grinder Designed to Simultaneously Deburr and Chamfer Both Ends of Gear Teeth

A twin-spindle, automatic, high-speed grinder designed to simultaneously deburr and chamfer the entire contour (heel and toe) of both ends of the teeth on spur, helical, or bevel gears has been announced by Michigan Tool Co., Detroit, Mich. The grinder drives reinforced wheels at 17,000 rpm with standard air spindles. Spindles rotate in proper directions to prevent wheels from digging in. The standard machine will handle gears having outside diameters from 3 to 13 inches. Other models are available for gears up to 20 inches OD.

To operate this machine it is only necessary to start the wheel spindles, place the gear on the fixture, and press two buttons to start the machine cycle. Where necessary, air clamping is provided. Many gears (see illustration) do not require clamping. The fixture starts rotating and tilts upward. Grinding-wheel spindles lower to contact the work and deburring starts. The grinding wheels are protected by the head during loading and offer no safety hazard.

After a pre-set number of rotations of the gear, during which the grinding wheels rise and fall to follow the contour of the heel and toe, the spindles are raised, the fixture is lowered to the unload position, and fixture rotation is stopped—all automatically. The number of rotations of the gear is determined by the depth of chamfer desired—the amount of material to be removed. The adjustable-cycle timer setting is determined by the number of rotations required and the pitch and size of the gear, and varies from twenty to sixty seconds per gear. Gear rotation speed is selectively adjustable, and counterweights incorporated in the spindles are adjustable to vary grinding pressure on the work.

All cylinders and wheel spindles are air-operated, with shop-air pressure regulated at the machine. Gear rotation is accomplished with a fractional-horsepower electric motor. Grinding wheels from 1.75 to 3.00 inches in diameter are used, depending on the size of gear. To equalize wear on both sides of wheels, they are interchanged on the spindles after about four hours. The operator is shielded by a protective hood but can view the process through a window in this hood. An exhaust outlet for dust-collector hookup is incorporated in the hood. Wheel-spindles are fully adjustable to permit positioning grinding wheels for different gear sizes.

Circle Item 593 on Inquiry card

Collector for Fume and Dust Control

The Pangborn Corporation, Hagerstown, Md., has developed a dust collector specifically to solve air-pollution problems arising from high-temperature fume and dust emissions. This Type "CO" cloth tube collector is designed for use with glass filter fabric, although it performs equally well with any type of filter fabric. The use of glass permits efficient filtration at temperatures as high as 550 degrees F.

where natural and synthetic fabrics are unsuitable.

Dust is collected on the inside surfaces of the filter tubes *D*, Fig. 1, which are cleaned by the "Pressure-Jet" method. A simple pressure jet *E* inside each filter tube provides short blasts of higher pressure air as indicated in view at left, Fig. 2, alternating with a small amount of reverse

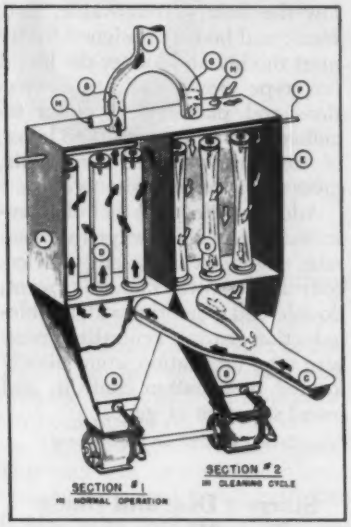


Fig. 1. Pangborn collector for fume and dust control

air flow from the main fan. This partially collapses the tubes *D* as shown at the right in Figs. 1 and 2, cleaning the filter surfaces and depositing the residue into storage hoppers *B* for easy disposal. The normal air flow is indicated by black arrows and the filtering reverse flow by outlined arrows.

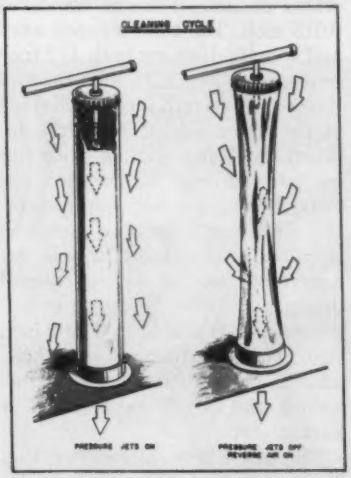


Fig. 2. Enlarged views of filter tubes (D) shown in Fig. 1

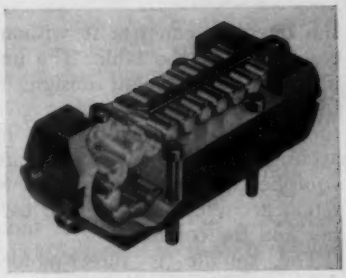
Intensity of the cleaning action may be regulated from a slight pulsation to the equivalent of mechanical shaking. Maintenance and service costs are said to be greatly reduced because cleaning is achieved without the filter-tube wear caused by mechanical shaking devices. Since there are no internal moving parts, stress and strain on casing and structural members are nonexistent.

The completely automatic Type "CO" is controlled by an adjustable electric program timer and is composed of multiple compartments. The new collector may be adapted to virtually any application, and is particularly effective in such problem areas as high-temperature drying, foundry cupolas, metallurgical furnaces, carbon-black recovery, and cement kilns.

Circle Item 594 on inquiry card

Tychoway Recirculating Roller Bearing

Recirculating roller bearing now being manufactured by Scully-Jones & Co., Chicago, Ill. This Tychoway bearing is now being used to help control friction to exacting limits on Kearney & Trecker's Milwaukee-Matic numerically controlled, multiple-purpose machine tool. Its precision rollers circulate through channels within the bearing case. An integral bearing race provides one rolling surface while the hardened and ground machine way serves as the other race. All working parts are through-hardened 52100 bearing steel with a calculated life of thirty years based on two-shift operation. The cutaway view of the new antifriction way bearing shows return channel, flat race, and recirculating rollers. Static load capacity of this bearing is 4250 pounds. By placing approximately a third of the full column weight (10,000 pounds) of Kearney & Trecker's Milwaukee-Matic on four Tychoway bearings, starting and running friction has been equalized, and any tendency toward fish-tailing eliminated and power requirements reduced. The new way



bearing system also permits the machine to repeat positioning accuracy to 0.0001 inch. Eight Tychoway bearings are used in V-way in the head where positive pre-loading with Belleville springs eliminates the need for upper and lower parallelism. Bearings perform the dual function of reducing friction and guiding the head, easily maintaining alignment accuracy of plus or minus 0.0002 inch.

Circle Item 595 on inquiry card

Improved Surface-Grinding Machine

A redesigned Footburt-Hammond No. 2 surface grinder has been announced by the Foot-Burt Co., Cleveland, Ohio. This precision hand-fed toolroom machine has been developed specifically for fine grinding where accuracy and finish are all important. Improvements include moving the push-button station from the column to the front side of the base where

Footburt-Hammond surface grinder

the operator can use it without reaching over the table. The unusual double-dovetail design of the spindle carrier is said to give the machine a high degree of accuracy. Both dovetails are equipped with adjustable gibs to retain accuracy between the carrier and the column.

The spindle is direct-motor-driven and is mounted on precision pre-loaded ball bearings. The spindle assembly with the motor is mounted in the spindle carrier as a unit. An Ex-Cell-O spindle assembly is furnished as standard but other makes are available. Total vertical spindle adjustment is 10 3/4 inches and maximum wheel size is 7 inches by 1/2 inch.

The table has a working surface of 6 by 18 inches, an in-and-out movement of 6 1/2 inches, and a longitudinal travel of 18 inches. It is operated by a unique roller-chain drive. The chain is anchored to the table at each end and passes over two idlers and around a sprocket on the handwheel. This drive is said to provide a smooth table travel that eliminates grinding patterns frequently seen when ordinary drives are used.

Circle Item 596 on inquiry card

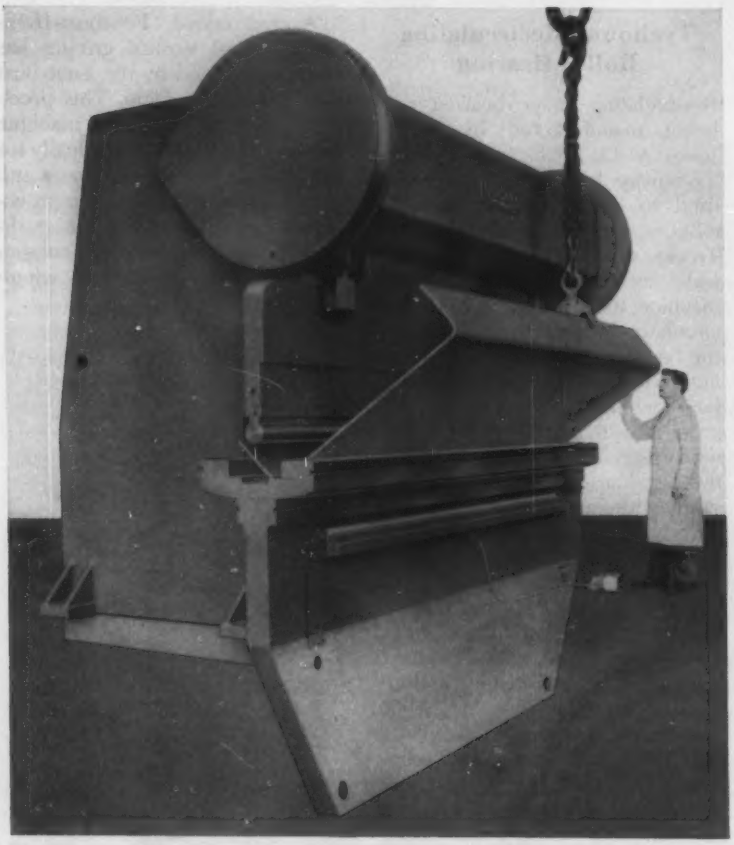
Niagara Redesigned and Enlarged Press-Brake Line

Series N press brakes embodying new design features and the expansion of its line of press brakes to cover a capacity range of 90 through 1500 tons have been announced by Niagara Machine & Tool Works, Buffalo, N. Y. Overall bed and ram lengths range from 6 to 24 feet, while bending capacities are for 12-gage to 1-inch mild steel. Outstanding among the design changes are: choice of power or manual clutch, brake, and treadle; two-speed transmission; rocker type end-guide bearings for precise, endwise alignment, even when the ram is tilted for taper work; and wide choice of special features and arrangements to meet individual conditions.

Streamlined in appearance, construction is of one-piece welded steel except in the larger sizes where the deep bed, extending below the floor, is removable. Both frame and bed are designed for utmost rigidity and longer die life. A box type crown encloses connections and places them closer together for a stiffer ram. The latter, of extra-heavy rolled-steel plate, gives maximum support to dies.

Additional features include: laminated nonmetallic ways for accurate alignment and long service; convenient power ram adjustment; double-end twin drive with double-reduction gearing; centralized pressure type lubrication; conveniently located push-button controls; and broad selection of gages.

Circle Item 597 on inquiry card



Series N press brake of redesigned line announced by Niagara Machine & Tool Works

Starrett Disc and Blade Type Micrometers

The L. S. Starrett Co., Athol, Mass., has recently added two types of micrometers to its line of precision measuring equipment. The No. 256 series disc type micrometer, Fig. 1, is designed to measure the thickness of closely spaced sections. It can be used where clearances are as limited as 0.015 inch. The thin, tapered anvil and spindle discs are both 1/2 inch in diameter and 1/16 inch thick at the center but only 0.015 inch thick at the outer edges. The thin, tapered anvil and spindle discs can be inserted into narrow grooves, slots, or recesses; between projecting ribs, lands, or fins; between steps on forming tools; or between gear teeth for measuring chordal thicknesses. This disc type micrometer is available in 0 to 1 inch size with graduations in thousandths of an inch. It can be furnished with or without lock-nut or ratchet stop.

The blade type micrometer, Fig. 2 (Starrett No. 486 series), is designed to facilitate measuring depths of narrow grooves, slots,

Fig. 1. Starrett disc type micrometer

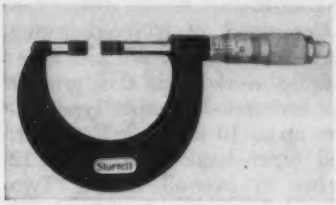


Fig. 2. Blade type micrometer made by the L. S. Starrett Co.

keyways, or recesses or for measuring diameters between lands, fins, or ridges such as on circular forming tools. The blade type anvil and spindle is only 0.030 inch thick and will measure depths up to 5/16 inch. The spindle is nonrotating and will not turn in a slot or roll off a narrow shoulder. This type micrometer is available in five size ranges: 0 to 1 inch, 1 to 2 inches, 1 1/2 to 2 1/2 inches, 2 1/2 to 3 1/2 inches, and 3 1/2 to 4 1/2 inches. All are graduated to read in thousandths of an inch with every thousandth numbered for quick reading. A convenient "speeder" on the end of the thimble permits its rapid turning for fast setting and measuring.

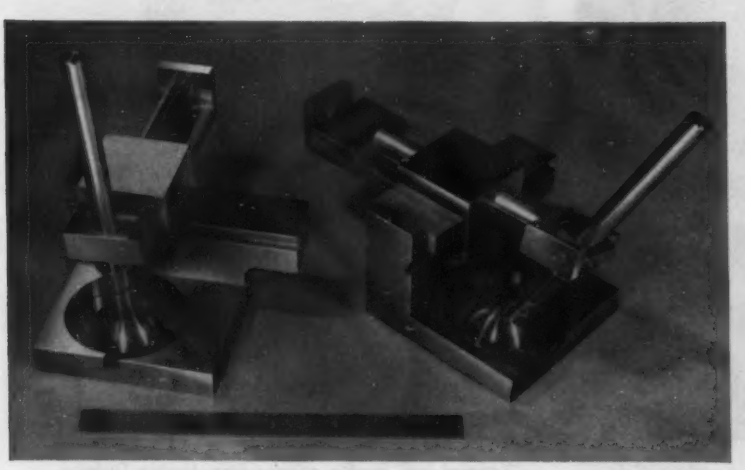
Circle Item 598 on inquiry card

Demill Compound Angle Setup Gage

A compound angle setup tool or gage which can be easily set to the required angles as they are read from the blueprint by the operator has been placed on the market by the Demill Co., Cleveland, Ohio. This gage can be used in conjunction with any work-holding device. It eliminates mathematical errors, since computations are eliminated and all angular settings are tabulated in one-minute increments.

The gage is simply based on the XYZ coordinate system used in drafting practice. Angles shown on blueprints appear in the XZ plane (front elevation) and YZ plane (side elevation). These angles are set directly on the gage with precision gage-blocks, and the indicator rod, riding on a fixed hemispherical surface, is moved automatically to the proper compound angle. The surface to be machined can be brought into position by indicating the rod. Another unique feature of the gage is that it can be used to locate a bore or hole in the proper position and at the proper angle on the work-piece.

The gage not only saves time by eliminating calculations, but it is also versatile, since it can be used with milling machines, surface grinders, jig borers, boring mills, and for inspection purposes. It can also be used as a visual aid for product and equipment design.



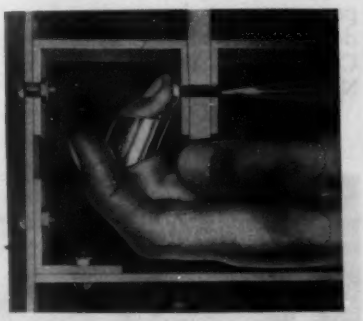
Compound angle setup gage placed on the market by the Demill Co.

The base is 3 by 3 1/8 inches with an over-all height of 5 3/4 inches. Settings for angles up to 45 degrees may be made simultaneously in both planes. The gage is made in two grades—the toolroom precision model which is accurate to 3 minutes at the maximum angle, and the inspection precision model accurate to 1 minute at the maximum angle.

Circle Item 599 on inquiry card

Wrench for Small Assembly Work

"Touch 'n Hold" finger-tip wrench introduced by Beaver Tool Co., Huntington Station, N. Y., that enables the user to reach into snug, narrow, remote, or hidden working areas and hold a nut or bolt in a true fixed position for assembly or disassembly. It is worn like a ring on the finger without restricting the free motion of the hands or



fingers. It is adjustable to fit different-size fingers and is supplied in the most popular hexagonal-head nut sizes.

Circle Item 600 on inquiry card

Liquid-Oxygen Manifold Has Automatic Change-Over

Liquid-oxygen cylinders can be furnished with a manifold introduced by the Linde Co., a division of Union Carbide Corporation, New York City. Used with four Linde LC-3 liquid-oxygen cylinders, the Oxweld M-40 manifold provides an uninterrupted supply of 12,000 cubic feet of oxygen. More than forty-eight conventional high-pressure cylinders would be needed to supply the same amount of oxygen. The new unit occupies only a fraction of the

space required for an equivalent high-pressure cylinder supply.

Designed for industrial or hospital use, the new manifold is expected to find widespread applications as a replacement for many existing systems of high-pressure cylinder oxygen supply. Automatic change-over from one bank to another is an important feature. As the supply in one cylinder bank is depleted, the manifold automatically continues to supply oxygen from the other, thus providing a continuous, uninterrupted supply. Standard models are available for use with four or two Linde LC-3 cylinders arranged in two banks.

Circle Item 601 on inquiry card

Skip Punching Device for Presses

A device that automatically programs a repetitive pattern of skipped and punched strokes in power-press operation has been developed by the Emhart Mfg. Co.'s Hudson Division, Hudson, N. Y.

The skip punching device was originally designed to control the slotting of motor laminations by notching machines according to a specified pattern of slots and spaces. It has now been successfully adapted for use on inclinable power presses where the work involves a repetitive pattern of punching and skipped strokes.

Although the unit becomes an integral part of the press when the control counter is set, the skip punching device can be disengaged and the press operated in the conventional manner by simply not setting the counter. The illustration shows the device built into the press slide for programming the punching of perforation patterns in muffler-tube blanks. The perforating die is shown in the up position for skip stroke.

Circle Item 602 on inquiry card

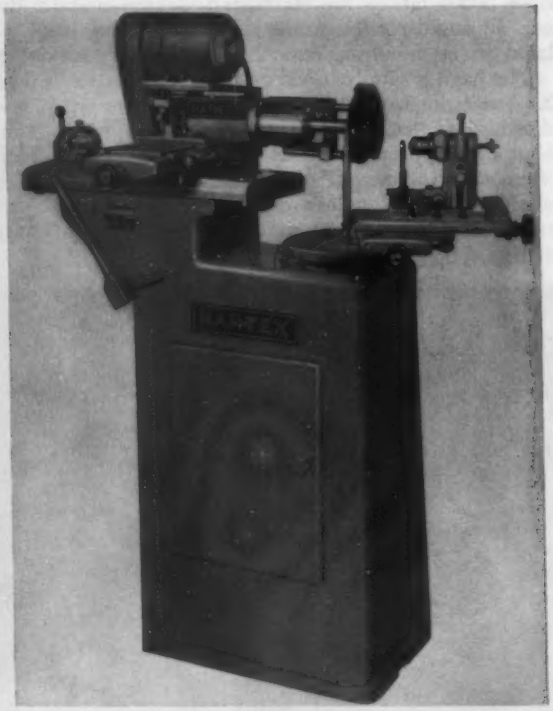
Hartex "Tangent-arc" Profile Grinder

The Hartex Division, Union Twist Drill Co., Athol, Mass., has announced the Hartex No. 3 "Tangent-arc" profile grinder. This machine is adapted for sharpening cutting tools having radii in the cutting surface and for grinding clearances on profile type, straight, or angular cutters. It was originally designed, developed, and used by the company for the manufacture of high grade cutting tools.

Composed of a reciprocating horizontal wheel-head and a revolving work-head, this grinder can accommodate arbor type cutters up to 10 inches in diameter, and taper-shank mills up to 12 inches in over-all length. Two cross-slides on the wheel-head and three slides on the work-head provide complete adjustment. The wheel-head reciprocates on precision ball slides. The work-head revolves on pre-loaded taper roller bearings and is provided with adjustable stops. Unobstructed visibility of working area and fingertip controls assure higher production and serve to lessen operator fatigue.

Circle Item 603 on inquiry card

Skip punching device developed by Emhart Mfg. Co., shown built into press slide

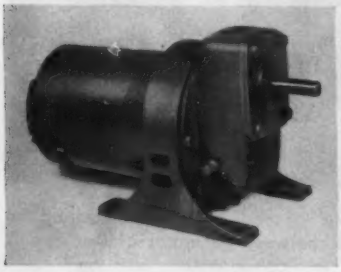


"Tangent-arc" profile grinder from Hartex Division, Union Twist Drill Co.

Fractional-Horsepower Gear Motors

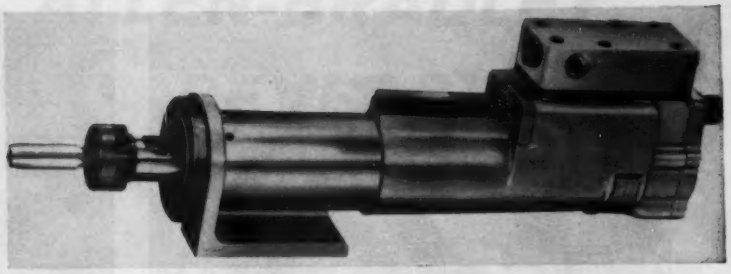
The General Electric Co., Schenectady, N. Y., has added to its line of alternating-current, fractional-horsepower gear motors lightweight models in ratings from 1/8 to 3/4 hp. These new models are right-angle and integral type designs with output speeds ranging from 197 down to 6 rpm, and 780 to 13.5 rpm, respectively.

General Electric Co.'s Gear Motor and Transmission Components Department, Paterson, N. J., has also announced a new fractional-horsepower motor-mounted brake. Rated at 3 pound-feet of torque, this brake is approximately 30 per cent lower in price than the previous design. The principal applications of this line are in the materials-handling, machine-tool, and food-machinery industries.



G-E fractional-horsepower gear motor with offset shaft

Circle Item 604 on Inquiry card



Stationary model Tru-Thread tapper brought out by the Gardner-Denver Co.

Tru-Thread Tappers

Automatic high-precision tapping without tearing or stripping of threads or tap breakage is said to be achieved by two new tappers having "controlled pitch" lead-screw feeds, brought out by the Gardner-Denver Co., Quincy, Ill. These tappers are designed for either portable or stationary applications. Models 93B-00 and 93B-5 find use in production manufacturing, airframe manufacturing, and construction work. The two sizes available cover the range of hole sizes from No. 2 to 1 inch in diameter, with a variety of speeds. The stroke is adjustable from a maximum of 1 1/2 inches for the 93B-00 and 3 inches for the 93B-5 to only 3/16 inch.

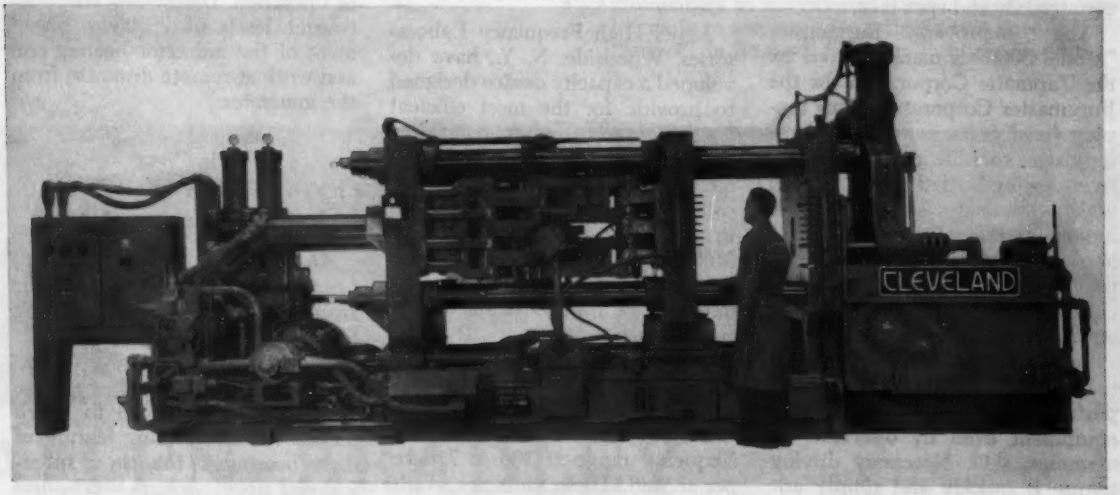
Circle Item 605 on Inquiry card

Giant-Size, Hot-Chamber Die-Casting Machine

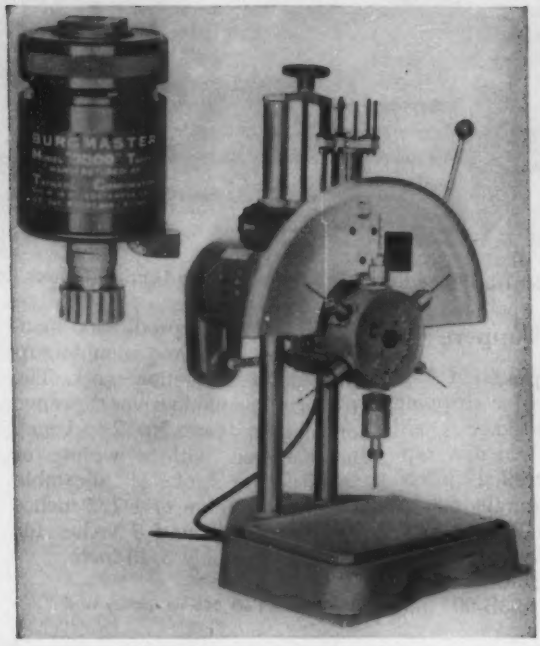
A hot-chamber die-casting machine built by the Cleveland Automatic Machine Co., Cincinnati, Ohio, and recently shipped to the Showa Die Cast Co., in Tokyo, Japan, is believed to be the largest of its type ever exported from the United States. Weighing approximately 57,000 pounds, it has a rated capacity of 850 tons but strain-gage testing revealed that it has a locking pressure as high as 950 tons. It is capable of making castings from molten zinc up to 30 inches by 40 inches in size, weighing 47 1/2 pounds, in one shot.

The platens are 54 inches wide by 55 inches high and 9 1/2 inches thick. They are machined from solid steel plate. The four tie-bars are 7 inches in diameter, and are supplied with indicator rods and dial indicators that provide quick, accurate adjustment of the tie-bar nuts to obtain even distribution of the locking-pressure load on all four bars. The machine is 8 1/4 by 24 1/2 feet by 10 feet high.

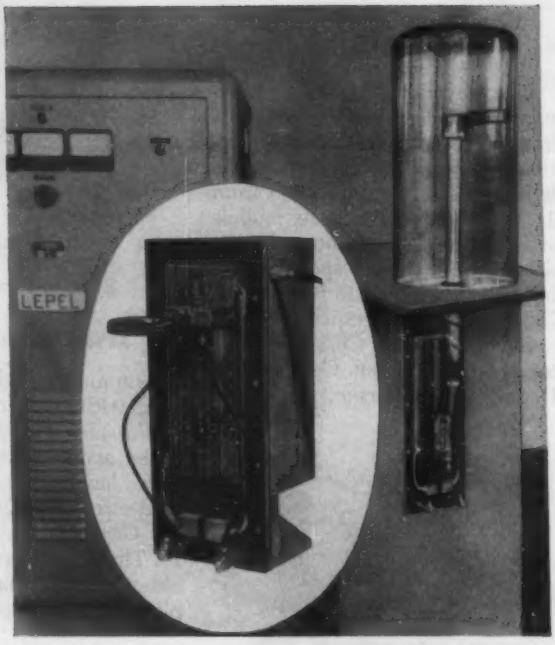
Circle Item 606 on Inquiry card



Hot-chamber die-casting machine built by the Cleveland Automatic Machine Co.



Bench model turret drill made by Burgmaster Corporation with improved tapper head made by Tapmatic Corporation



Lepel "CT Matching Unit" of modular design developed for efficient energy transfer between generator and work coil

Burgmaster Turret Drill with Improved Tapping Head

Through the use of an improved tapping head, the tapping capacity of the bench model turret drill made by the Burgmaster Corporation, Gardena, Calif., has been increased from No. 0 to No. 6 to the full range between No. 00 and No. 10-24 taps. This machine, with 1/4-inch drilling capacity in steel, is a sensitive, six-spindle, power-indexed turret drill which is used to drill, ream, tap, counterbore, countersink, and spot-face.

The improved Burgmaster "Model 3000" is manufactured by the Tapmatic Corporation for the Burgmaster Corporation. This tapping head features an axial-floating-drive spindle and supersensitive spring-loaded ball clutch which eliminates many of the human and mechanical problems associated with conventional tapping equipment. No friction clutches, planetary gears, or leadscrews are used in its design.

Tap breakage is said to be virtually eliminated and consistently perfect threads produced with this equipment even by operators of minimum skill. Necessary driving torque is quickly and simply adjusted prior to the actual tapping operation and cannot be changed by the operator while tapping. Reversing torque is automatically increased or decreased when driving-torque adjustments are made. The tap stops instantly when it becomes dull, loaded, or bottoms in blind-hole tapping.

Circle Item 607 on inquiry card

Induction-Heating Equipment

Lepel High Frequency Laboratories, Woodside, N. Y., have developed a capacity device designed to provide for the most efficient energy transfer, when connected between a high-frequency generator and a low-impedance work coil. Details of this unit are shown in the inset. This Lepel "CT Matching Unit" is modular designed, has a heavy copper terminal of low impedance and a high current-carrying capacity. It is designed for attachment to either the induction-heating coil directly or to coaxial leads. Each section of this unit is rated at 100 kva in the frequency range of 100 to 750 kc per second. These units are available in 1, 2, 4, 6, and 8 sections, rated at 100, 200, 400, 600, and 800 kva, respectively. Combinations of parallel and series connections between the individual sections provide several ranges of impedance, permitting efficient matching to even the smallest induction-heating coils.

The illustration shows the CT unit employed with coaxial leads for transmission into a bell jar. This arrangement permits operation at the lowest voltage consistent with the power demand and frequency of operation. Use of this unit with coaxial leads also allows placement of the induction-heating coil and work at remote distances from the generator.

Circle Item 608 on inquiry card

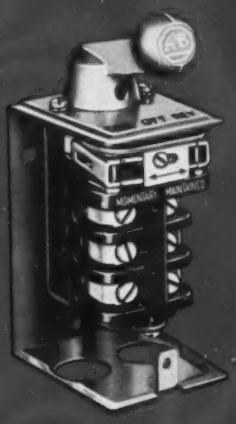
Kaydon Thin-Shell Needle Bearings

An expanded line of thin-shell needle bearings is now available from the Kaydon Engineering Corporation, Muskegon, Mich. It includes fourteen sizes of "off-the-shelf" needle bearings in bore sizes ranging from 3/8 to 1 3/8 inches. An outstanding feature of these bearings is the use of spherical-end needle rollers, vast num-

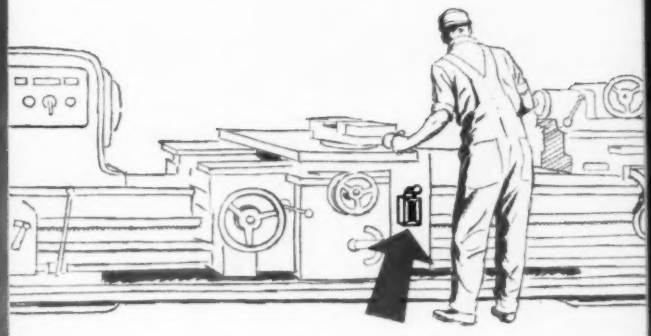
(Continued on page 188)

ALLEN-BRADLEY

REVERSING DRUM SWITCHES



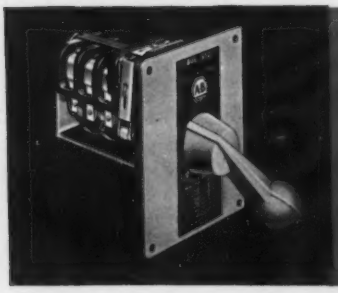
BULLETIN 350
Style A wrap-around cover is removed to show the readily accessible front wiring terminals. Max rating: 2 hp.



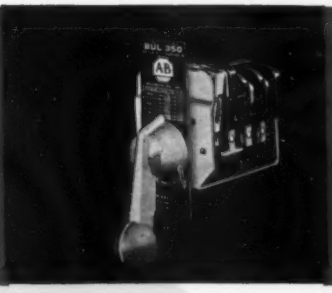
...styled to match the most modern production machines!

Inside and out—this Allen-Bradley drum switch is *all* new. Its trim, modern lines and attractive die-cast aluminum handle will give your production machines "up-to-the-minute" styling.

But there is more than beauty to this new switch. The rugged switch mechanism is a self-contained unit—independent of the enclosure. Misalignment and binding *cannot* occur. The base mounts directly on machine surfaces—without using spacers. And with the wrap-around cover removed, terminal screws are exposed for fast wiring—from the front. Changeover from momentary to maintained contact operation can be made in seconds. Investigate this new "leader" in its field. Send for Publication 6091.



OILTIGHT CAVITY MOUNTING
A-B Style AF reversing switches can be furnished with sealed shaft and rubber-gasketed, oiltight cover for cavity mounting in a machine base.



PANEL MOUNTING
The new Style A switches can be furnished for mounting directly on panels. Nameplate which gives ratings is also included with each switch.

ALLEN-BRADLEY

Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

3-60-P

ALLEN-BRADLEY
Solenoid Starters give

MORE MILLIONS OF TROUBLE FREE OPERATIONS

. . . and for good reasons

• ONE MOVING PART

With this simple solenoid design, there's virtually nothing to go wrong—all trouble-causing bearings, pivots, and flexible jumpers have been eliminated.

• DOUBLE BREAK, SILVER ALLOY CONTACTS

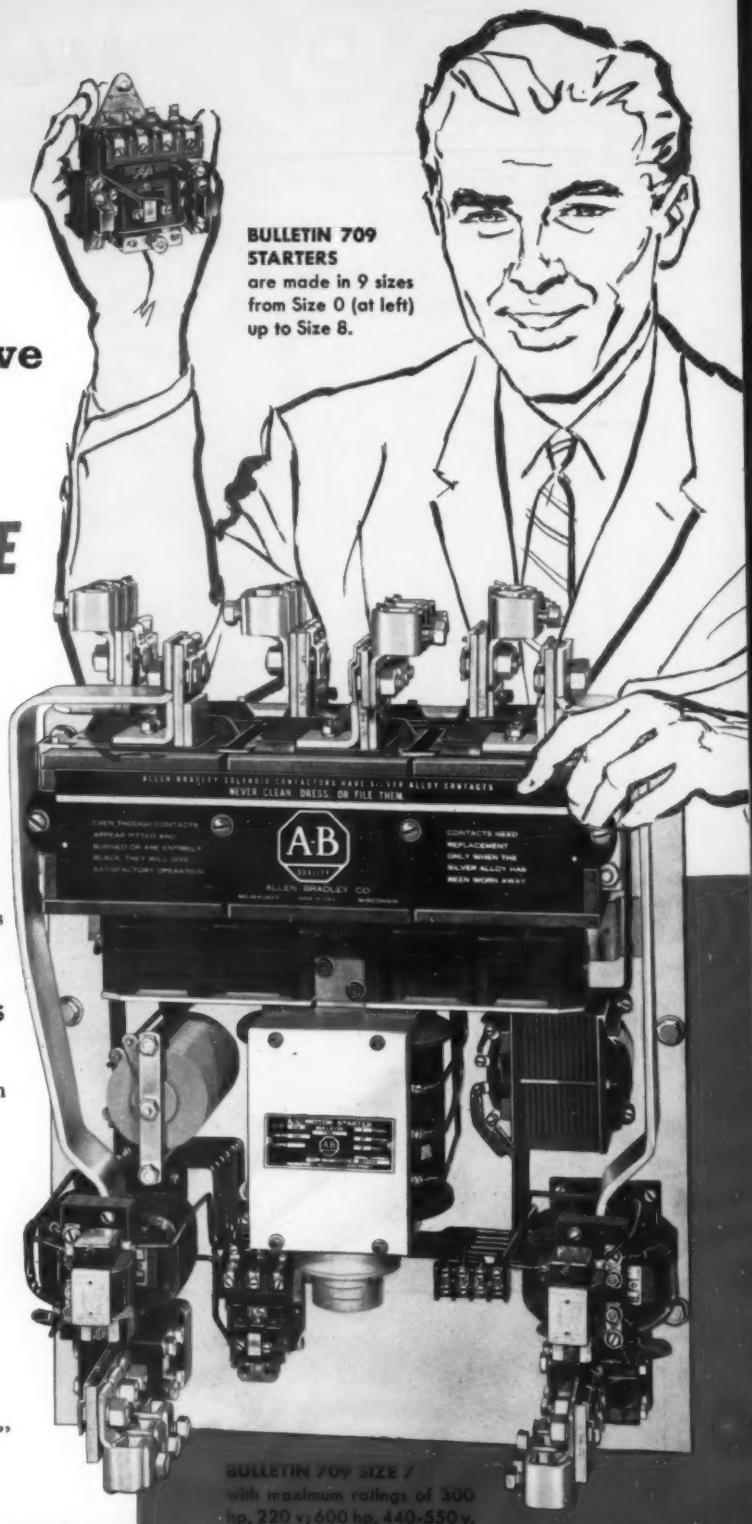
Allen-Bradley silver alloy contacts never require maintenance. They are always in perfect operating condition . . . and remain so until completely worn away.

• SIMPLE UP-AND-DOWN MOTION

The virtually frictionless, straight line vertical motion provides uniform contact pressure at all times—and assures consistent, rapid operation of the contactor.

• RELIABLE OVERLOAD PROTECTION

All A-B starters are equipped with two permanently accurate and reliable overload relays that protect motors against "burnouts." Three overload relays can be furnished.



BULLETIN 709 STARTERS are made in 9 sizes from Size 0 (at left) up to Size 8.

BULLETIN 709 SIZE 7 with maximum ratings of 300 hp, 220 v.; 600 hp, 440-550 v.

ALLEN-BRADLEY
MEMBER OF NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

3-60-B

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—5

Regular Hand Taps

Carbon Steel—Cut Thread
High-Speed Steel—Cut Thread
High-Speed Steel—Ground Thread

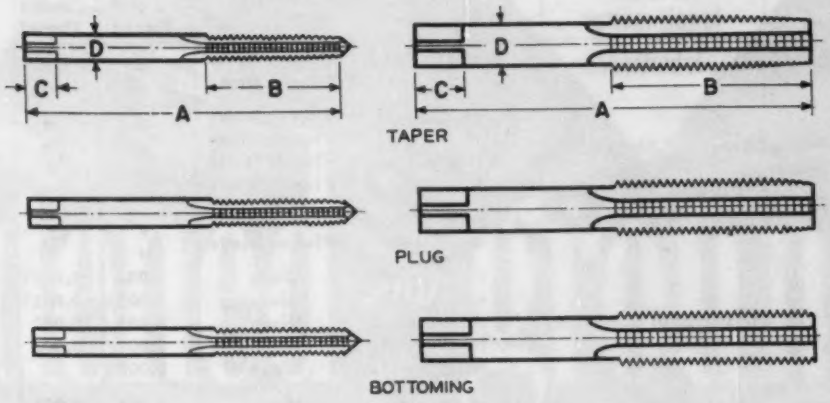


Table I General Dimensions

Diameter of Tap	Threads per Inch						Number of Flutes	Dimensions				
	Carbon Steel			High-Speed Steel				Length Overall	Length of Thread	Length of Square	Diameter of Shank	Size of Square
	NC UNC	NF UNF	NS	NC UNC	NF UNF	NS		A	B	C	D	E
1/16	...	..	64	..	..	...	2	1 5/8	5/16	3/16	0.141	0.110
5/32	...	..	48	..	..	...	3	1 13/16	1/2	3/16	0.141	0.110
1/8	...	..	40	..	..	...	3	1 15/16	5/8	3/16	0.141	0.110
5/32	...	..	32,36	..	..	...	4	2 1/8	3/4	1/4	0.168	0.131
3/16	...	..	24,32	..	..	...	4	2 3/8	7/8	1/4	0.194	0.152
7/32	...	..	24,32	..	..	...	4	2 3/8	15/16	9/32	0.220	0.165
1/4	20	28	24,32†	20	28	...	4	2 1/2	1	9/32	0.255	0.191
5/16	18	24	32†	18	24	...	4	2 23/32	1 1/8	5/16	0.318	0.238
3/8	16	24	..	16	24	...	4	2 15/16	1 1/4	3/8	0.381	0.286
7/16	14	20	..	14	20	...	4	3 5/32	1 7/16	13/32	0.323	0.242
1/2	13	20	..	13	20	...	4	3 3/8	1 21/32	7/16	0.367	0.275
9/16	12	18	..	12	18	...	4	3 19/32	1 21/32	1/2	0.429	0.322
5/8	11	18	..	11	18	...	4	3 13/16	1 13/16	9/16	0.480	0.360
11/16	...	..	11,16	..	..	11, 16	4	4 1/32	1 13/16	5/8	0.542	0.406
3/4	10	16	..	10	16	...	4	4 1/4	2	11/16	0.590	0.442
7/8	9	14	..	9	14	...	4	4 11/16	2 7/32	3/4	0.697	0.523
1	8	12	14	8	12	14	4	5 1/8	2 1/2	13/16	0.800	0.600
1 1/8	7	12	..	7	12	...	4	5 7/16	2 9/16	7/8	0.896	0.672
1 1/4	7	12	..	7	12	...	*4	5 3/4	2 9/16	1	1.021	0.766
1 3/8	6	12	..	6	12	...	*4	6 1/16	3	1 1/16	1.108	0.831
1 1/2	6	12	..	6	12	...	*4	6 3/8	3	1 1/8	1.233	0.925
1 3/4	5	..	..	..	..	...	6	7	3 3/16	1 1/4	1.430	1.072
2	4 1/2	..	..	..	..	...	6	7 5/8	3 9/16	1 3/8	1.644	1.233

All dimensions are given in inches.
*NF - UNF thread taps have six flutes in these sizes.
† NEF—UNEF

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—6

Regular Hand Taps

Carbon Steel—Cut Thread
High-Speed Steel—Cut Thread and Ground Thread

Tolerances

Element	Range	Direction	Tolerance	
			Cut Thread	Ground Thread
Length Overall (A)	1/16 to 1 incl.	Plus or Minus	1/32	1/32
	1 1/8 to 2 incl.	Plus or Minus	1/16	1/16
Length of Thread (B)	1/16 to 7/32 incl.	Plus or Minus	3/64	3/64
	1/4 to 1/2 incl.	Plus or Minus	1/16	1/16
	9/16 to 1 1/2 incl.	Plus or Minus	3/32	3/32
	1 5/8 to 2 incl.	Plus or Minus	1/8	
Length of Square (C)	1/16 to 1 incl.	Plus or Minus	1/32	1/32
	1 1/8 to 2 incl.	Plus or Minus	1/16	1/16
Diameter of Shank (D)	1/16 to 7/32 incl.	Minus	0.004	0.0015
	1/4 to 5/8 incl.	Minus	0.005	0.0015
	11/16 to 1 incl.	Minus	0.005	0.002
	1 1/8 to 1 1/2 incl.	Minus	0.007	0.002
	1 5/8 to 2 incl.	Minus	0.007	
Size of Square (E)	1/16 to 1/2 incl.	Minus	0.004	0.004
	9/16 to 1 incl.	Minus	0.006	0.006
	1 1/8 to 2 incl.	Minus	0.008	0.008

All dimensions are given in inches.

These taps are furnished in taper, plug, or bottoming style, except that ground thread taps:
1/4 to 1/2" diameter inclusive in L1 limit
1/4 to 3/8" diameter inclusive in H4 limit
1/4 to 1" diameter inclusive in H5 & H6 limits
are standard in plug and bottoming style only.

High Speed Steel Cut Thread taps are standard in sizes 1/4 to 1" inclusive.

Cut thread tap sizes smaller than 11/32" have external center on thread end; sizes 11/32" and larger have internal center in thread end.

All ground thread taps 1/4" and larger have internal center in thread end.

Machine Screw taps are recommended for sizes under 1/4".

Eccentricity Tolerances of Tap Elements When Tested on Dead Centers

Element	Range Sizes are Inclusive		Cut Thread		Ground Thread	
	Hand Mch. Screw	Pipe	Eccentricity	t.i.v.*	Eccentricity	t.i.v.*
Square (at central point)	#0 - 1/2"	1/16 - 1/8"	0.0030	0.0060	0.0030	0.0060
	17/32 - 4"	1/4 - 4"	0.0040	0.0080	0.0040	0.0080
Shank	#0 - 5/16"	1/16"	0.0030	0.0060	0.0005	0.0010
	11/32 - 4"	1/8 - 4"	0.0040	0.0080	0.0008	0.0016
Major Diameter	#0 - 5/16"	1/16"	0.0025	0.0050	0.0005	0.0010
	11/32 - 4"	1/8 - 4"	0.0040	0.0080	0.0008	0.0016
Pitch Diameter (at first full thrd.)	#0 - 5/16"	1/16"	0.0025	0.0050	0.0005	0.0010
	11/32 - 4"	1/8 - 4"	0.0040	0.0080	0.0008	0.0016
Chamfer**	#0 - 1/2"	1/16 - 1/8"	0.0020	0.0040	0.0010	0.0020
	17/32 - 4"	1/4 - 4"	0.0030	0.0060	0.0015	0.0030

* t.i.v. = total indicator variation. Figures are given for both eccentricity and total indicator variation to avoid misunderstanding.

** Chamfer should preferably be inspected by light projection to avoid errors due to indicator contact points dropping into the thread groove.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

For emergency needs call collect
MAnhasset 7-1800

ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

THOMSON INDUSTRIES Inc.
Dept. C-9. Manhasset, New York

PARTS HARDENED to 60 C...
increase life... reduce cost!

bers of which have been used for automotive transmissions and universal joints.

Spherical-end needle rollers are said to permit these thin-shell bearings to have up to 90 per cent greater capacity and up to 6.85 times longer life than comparable bearings with conical-end rollers. This greatly increased capacity allows the use of smaller bearings for a given load requirement.

Bearings now available range from 9/16 inch to 1 11/16 inches in outside diameter, and from 1/4 inch to 1 1/8 inches in width. All sizes exceed requirements for operation at speeds up to 6000 rpm. Rollers are made of high-carbon, chromium alloy steel with a minimum hardness of Rockwell C 60. Shells are made of electric-furnace bearing steel.

Circle Item 609 on Inquiry card

Power Straightener for Coiled Stock

Coiled material up to 16 inches in width and up to a maximum thickness of 1/4 inch (cold-rolled steel, hot-rolled steel, brass, copper, and aluminum) can be handled on the Model No. PDS-16H power straightener announced by U. S. Tool Co., Inc., Ampere, N. J. This unit is designed for the removal of coil set from material in coil form and is usually used in conjunction with automatic feeding equipment for advancing the material into punch presses, press brakes, or other fabricating equipment.

The straightener is arranged with a pair of power-driven take-in rolls and six straightening rolls. The rollers are 4 inches in diameter and spaced 6 inches on centers. The upper three rollers are individually adjustable and the lower three are power-driven. There is also a pair of power-driven take-out rolls. A quick release is provided for take-in and take-out rolls. All rolls are hardened and ground, mounted in bronze bearings and driven by means of hardened gears.

The unit has loop control with an electric clutch, casters for portability, and a 5-hp variable-speed drive unit with outputs from 10 to 50 feet per minute.

Circle Item 610 on Inquiry card

Measuring Instrument for Lathe

An instrument called the "Distometer" (Model 555 B-245), designed to provide the lathe operator with a fast, convenient, reliable means of spotting tool positions and directly measuring longitudinal cutting distances, has been announced by the Federal Products Corporation, Providence, R. I. With this instrument the operator has a constant guide which operates over the full travel of the lathe carriage, can be referenced instantly at any point in the travel with push-button zeroing, and can measure movement continuously to any other point.

Dial graduations are in increments of 0.002 inch and the range per revolution of the pointer is 0.500 inch. A revolution counter is divided into ten segments, each of which represents one complete revolution of the large hand. There is no need for the operator to hold scales, adjust dials, or take time out to check work or tool settings against gage-blocks. The Distometer is mounted on the lathe carriage so that it travels with the tool. It is actuated by its movement along a stationary tape mounted rigidly to the lathe bed and is equally effective whether cutting shoulders, grooves, or bores.

In on-the-job tests, the use of the Distometer is said to have actually increased lathe production more than 27 per cent and been responsible for an increase in output of better than two to one. Indexing time, which included manual return of the tool and adjustment for depth of cut as well as actual measurement of length, was also materially reduced.

Circle Item 611 on Inquiry card

(This section continued on page 190)

Power-driven coiled-stock straightener announced by U. S. Tool Co., Inc.

Lathe equipped with "Distometer" measuring instrument announced by Federal Products Corporation

Cost-Cutting-

A SIMPLE MATTER OF SELECTION

59-15

COUNTERBORE SETS

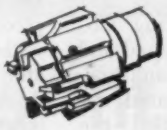
INVERTED SPOT FACERS

COUNTERBORES—

COUNTER SINKS, HOLDERS, PILOTS

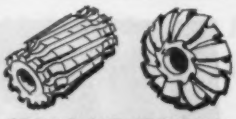
FLOATING TAP DRIVERS

INSERTED BLADE FACE MILLS



MULTIPLE DIAMETER BORING CUTTERS

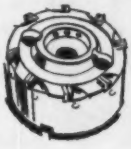
GROUND MULTIPLE THREAD MILLING CUTTERS



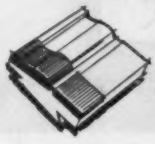
GROUND AND UNGROUND FORM-RELIEVED CUTTERS

SINGLE-POINT CARBIDE TIPPED TOOLS

MULTIPLE STEP BORE REAMERS



CARBIDE TIPPED CYLINDER BORING CUTTERS



DOVETAIL FORM TOOLS

CARBIDE TIPPED BROACH SECTIONS

INVOLUTE SPLINE SHELL TYPE BROACHES

Every standard and special tool is of but one quality—the finest available. Since 1921, Continental has specialized in cost-saving cutting tools (just a few of which are shown at left), producing design innovations in hardened, high-speed tool steel, carbide and special-alloy cutting materials.

Available in the types and sizes required to do the *complete* job from rough to finish, Continental Cutting Tools are job-tested in the toughest proving ground—Ex-Cell-O's own machine tool and precision parts production lines. As a result, they come to you ready to increase the output of even your best machines!

Continental engineers will be glad to work with you in selecting the correct CTW Cutting Tool for long life and maximum performance. See your local Ex-Cell-O Representative, or write direct to Continental Tool Works Division for full details. In Canada, contact your local Ex-Cell-O Sales Associates Representative or write direct to Colonial Tool Co., Ltd., Windsor.

Continental **TOOL WORKS**

DIVISION OF

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

Four series of HDR high-precision radial ball bearings available from Split Ballbearing, Division of MPB, Inc.

Heavy-Duty Precision Ball Bearings

A line of heavy-duty split ball bearings of a unique single-fracture design that permits the use of a maximum number of balls has been announced by Split Ballbearing, a division of MPB, Inc., Lebanon, N. H. The manufacturing method consists of fracturing the outer ring of the bearing at one point and spreading it sufficiently to allow the assembly of a maximum complement of balls. The full-depth, symmetrical raceways with no loading slots provided by this method of assembly permit the bearings to carry thrust loads from either direction. The one-piece, outer land-riding bronze retainer has high strength and serves to improve internal lubrication and permit higher operating speeds.

Increased load capacity, longer life, and greater rigidity are among the advantages claimed for these HDR bearings. They are available in ABEC-3 and ABEC-5 precision grades in extremely light, extra-light, light, and medium series, in metric sizes up to 85 mm O.D. The standard material for rings and balls is 52100 steel. Four ranges of internal clearance allow designers a wide variety of operating characteristics. The illustration shows type HDR ball bearings with the same bore size but different capacities, representing the four series ranging from extremely light to medium.

Circle Item 612 on inquiry card

Equipment for Handling Delicate Parts

The Air-Vac Engineering Co., Shelton, Conn., has developed and placed on the market a multiple-purpose hand tool operated entirely by vacuum. Called the "Bazooka Vacuum Probe," it permits fast handling and accurate, efficient control in sub-assembly operations on small, delicate, hard-to-manage parts.

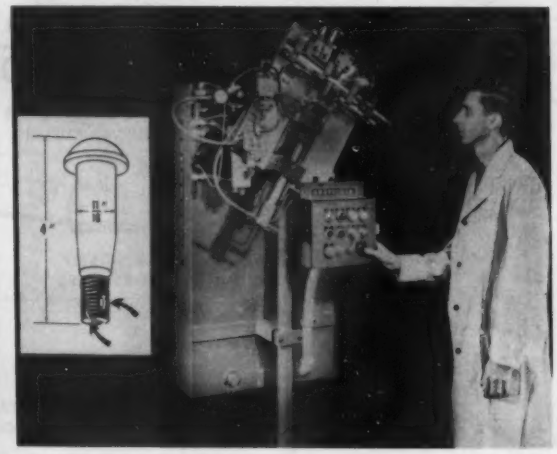
Also available is a compact vacuum system that provides vacuum wherever there is compressed air. All that is required is to connect it to a standard compressd-air line. Damage to finished parts of any material cannot occur during inspection when using this equipment. The use of vacuum eliminates the pinching or nicking of small, delicate, or unbalanced parts that often occurs when other means of inspection or handling are used. The Vacuum Probe itself is designed to fit comfortably in the operator's hand which greatly minimizes fatigue during long continuous periods of use. A wide range of plastic tips is available to meet the requirements of any inspection operation and also perform the many assembly operations required in manufacturing.

Circle Item 613 on inquiry card

Hole and Slot Checking Machine

An automatic inspection and segregating machine that checks the presence of a cotter-pin hole and a screwdriver slot in a plain or threaded stud at the rate of 2500 pieces per hour, ejecting those without holes and slots immediately after inspection, has been designed and built by the Instruments and Systems Division of the

"Bazooka" vacuum and vacuum transducer equipment for handling and inspecting small parts



Sheffield automatic inspection and segregating machine for ball-joint stud

Revere helps "fit the metal to the job"

AND A MAKER OF MEDICINE CABINET MIRROR FRAMES SAVES $10,000 A YEAR

As a result of a suggestion made by one of Revere's Technical Advisors, a maker of mirror frames for medicine cabinets has saved $10,000 a year on polishing costs alone. The suggestion was that, by changing to a brass of different grain size, the manufacturer might be able to save money on polishing costs and at the same time improve the quality of his product. (The 90° bend to which the mirror frames are subjected also had to be taken into consideration.)

Samples were made using a Revere Brass Strip with a smaller grain size as recommended by the Technical Advisor. Tests showed that, as a result of the change the manufacturer was able to realize a saving of 17¢ per mirror frame on polishing costs alone, with no increased costs in other operations, including the 90° bend. Based on the saving per frame this manufacturer has saved $10,000 per year for the past 4 years!

Here is still another example of how Revere's Technical Advisory Service working with the customer and the mill helped "fit the metal to the job," thus saving the customer money as well as improving product quality.

Why don't you take advantage of the extensive knowledge of Revere's Technical Advisory Service in "fitting the metal to the job?" It's entirely possible this service can save you money . . . help improve the quality of *your* product.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

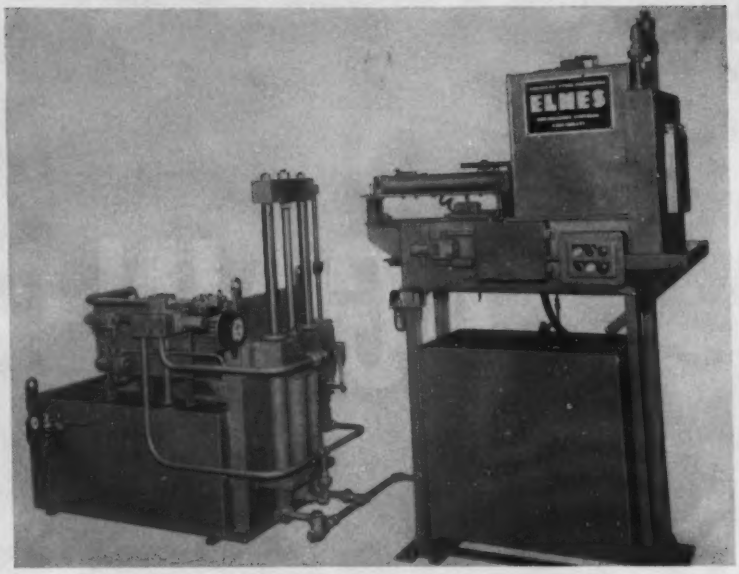
Executive Offices: 230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Fort Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. The front suspension upper and lower arm ball-joint stud shown at the left in the illustration is a typical part gaged on this machine. Four different-size studs can be checked by using interchangeable tooling.

The studs are gravity-fed into the machine along slide rails, entering the checking station singly, slot-end down. The bottom half of the stud seats into a receiver ring where controlled air flow detects the presence or absence of the hole, and a Sheffield Airlectric control unit converts the pneumatic impulse into electrical signals to actuate a stamping device if the part is acceptable or is to be rejected. The presence of a screwdriver slot is checked with a probe operating against a micro switch. This type of "detecting" station is now being used in many automation transfer machines.

Circle Item 614 on Inquiry card



Elmes billet descaler with separate, portable power unit

Automatic Billet Descaler

A billet descaler with the power unit separated from the descaling cabinet to minimize floor-space requirements has been announced by American Steel Foundries, Elmes Engineering Division, Cincinnati, Ohio. The hydraulic power unit can be mounted remotely from the descaling cabinet in any convenient location. The power unit has stainless-steel rams and bronze trimming, the rams being fastened to the hydraulic unit in a vertical position to conserve floor space.

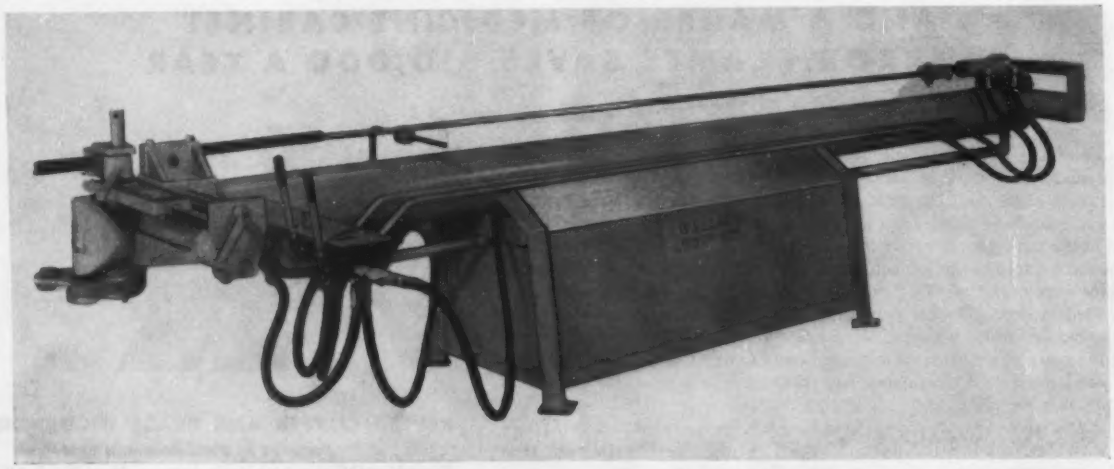
Adjustable billet-ejection speed and an ejection chamber arranged to accommodate a variety of sizes and shapes of billets are features of the descaling cabinet.

The scale basket can readily be removed with a forked truck, or the complete descaling unit can be picked up by the truck and moved to another location. Billet sizes range from 3- to 5-inch rounds 3 to 10 inches long, and from 2 1/4- to 7-inch round-cornered squares 5 to 8 inches long. Operation of the descaler is automatic and is triggered by the entry of the billet into the descaling cabinet.

Circle Item 615 on Inquiry card

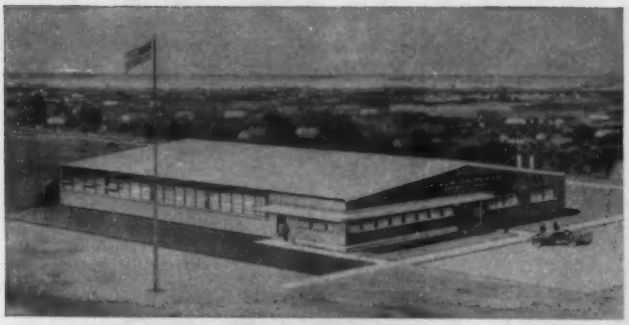
Wallace Line of "S-M" Bending Machines

A line of "S-M" machines for bending pipe, tubes, angles, channels and other structural shapes in any bendable metal, as well as rolled or extruded special shapes, has been introduced by the Wallace Supplies Mfg. Co., Chicago, Ill. These S-M benders are now



"S-M" bending machine built in four sizes by Wallace Supplies Mfg. Co.

ANOTHER EXPANSION to Better Serve Industry in the Soaring Sixties



PLANT No. 4—ELK RAPIDS, MICHIGAN

PLANT No. 2—DETROIT, MICHIGAN

PLANT No. 3—MANCELONA, MICHIGAN

The recent opening of our Plant No. 4 in Elk Rapids, Michigan, marks the fourth expansion in our manufacturing facilities since we set up in business 35 years ago. In the intervening years, we have earned an international reputation for designing and building money-saving machine tools for many types of industries. We have also diversified our engineering and production talents so that our machines, which originally were specialized in metal-cutting operations, now reach into the nuclear power, electronic, chemical, drug, cosmetic and food industries and are used in processing many household products in everyday family use. To the many people who have helped us build this business, we say, "Thank you, sincerely."

SNYDER CORPORATION
and our subsidiary

ARTHUR COLTON COMPANY

3400 E. Lafayette Avenue • Detroit 7, Michigan

PLANT NO. 1—DETROIT, MICHIGAN

For more data circle this page number on card at back of book

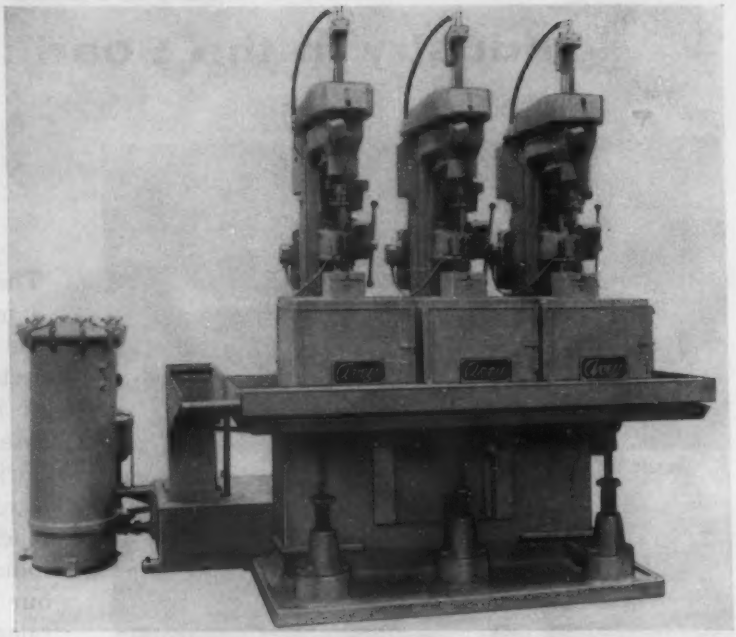
available in four sizes for handling work from approximately 2-inch to approximately 8-inch standard pipe sizes. The machines employ hydraulic power to produce 90-degree bends plus spring-back on one setting and 180-degree bends plus spring-back on a second setting. They are available with or without mandrel units and can be equipped to provide clamping and power-pressure die movement.

Circle Item 616 on inquriy card

Avey Gun-Drilling Machine

A gun-drilling machine incorporating three Avey No. 2 BMA-5 top columns on a six-spindle lower column base and table has been built recently by the Avey Division of Motch & Merryweather Machinery Co., Cincinnati, Ohio. The spindles have an overhang of 12 inches and are spaced 24 inches between centers. They have power feed with fine-feed reducers and No. 2 or No. 3 Morse taper with holes drilled through the spindles for high-pressure lubrication supply to single-lip carbide gun drills. Speeds range up to 8000 rpm.

The machine includes a high-pressure pump and tank unit with a Briggs filtration unit. Each spindle is individually guarded for splash protection from the high-pressure lubricating system. A large door in front of each spindle enables the operator to load and unload the part.



Avey six-spindle gun-drilling machine

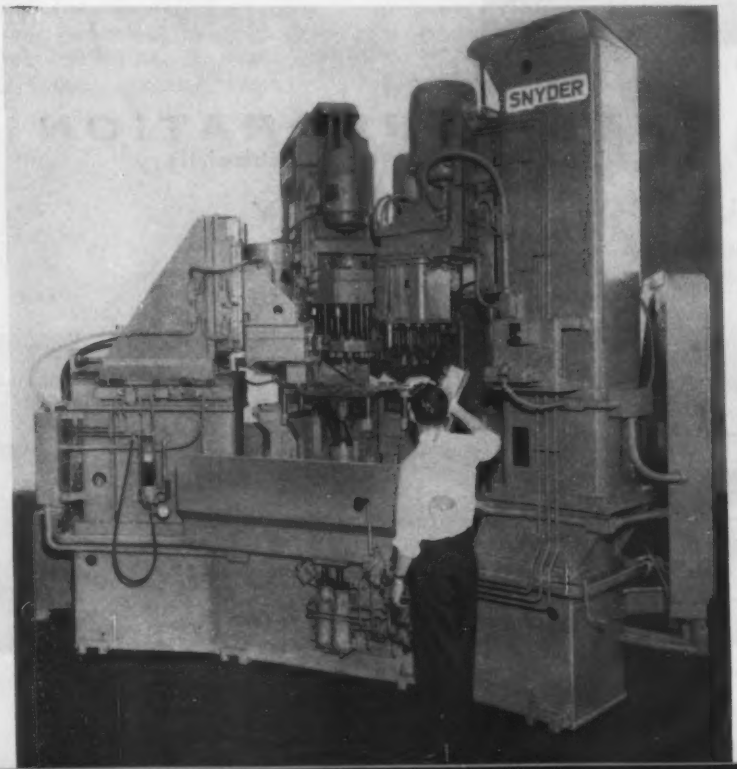
Circle Item 617 on inquiry card

Snyder Five-Station Rotary Index Machine

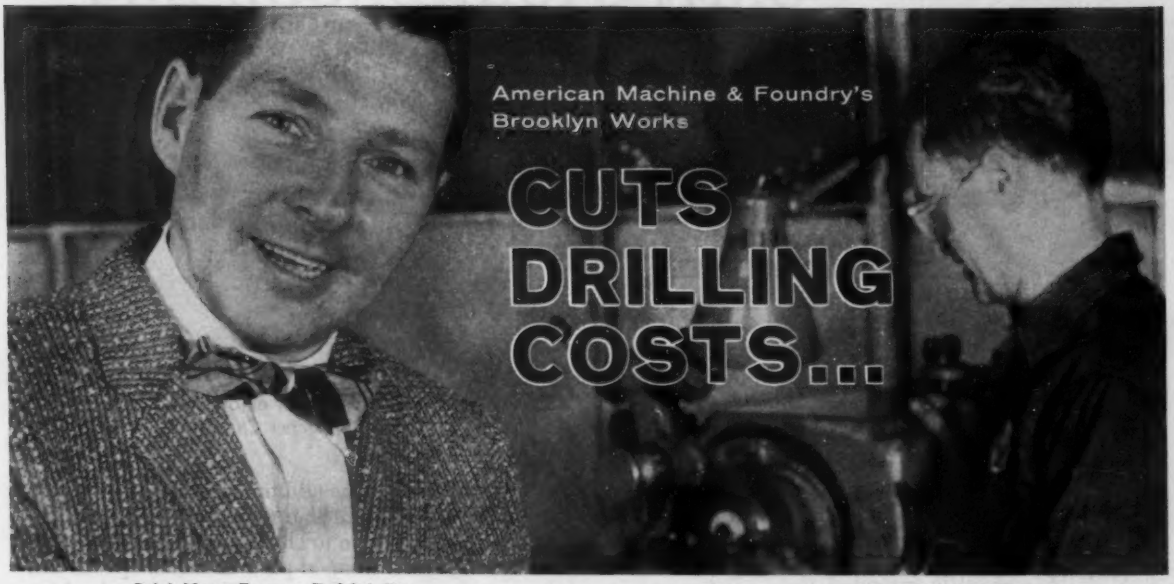
A special rotary index machine that mills, drills, countersinks, and taps compact car differential carriers at a rate of ninety-seven parts per hour at 100 per cent efficiency is announced by the Snyder Corporation, Detroit, Mich. A spot-facing operation for four recessed hole faces in the carrier is performed by a unique face-milling operation on this machine. A two-spindle milling head is first fed to depth, traversed sideways in one direction to face two of the hole surfaces, and then fed in the opposite direction and back to center position to face the other two surfaces.

This hydraulically operated, electrically controlled machine is made up of a building-block assembly of Snyder standard-way type machining units, columns, and a rotary index mechanism. Hydraulic power is supplied by a separate motorized hydraulic pump and tank unit. The control panel is on the side of machine.

Circle Item 618 on inquiry card



Special machine for processing car differential carriers



Ralph Mazza, Foreman, Tool Grinding and Small Tool Department

At AMF, the Cincinnati SPIROPOINT sharpens spiral point drills for 10 radials, 60 sensitive drill presses and 20 multiple-spindle multiple head units.

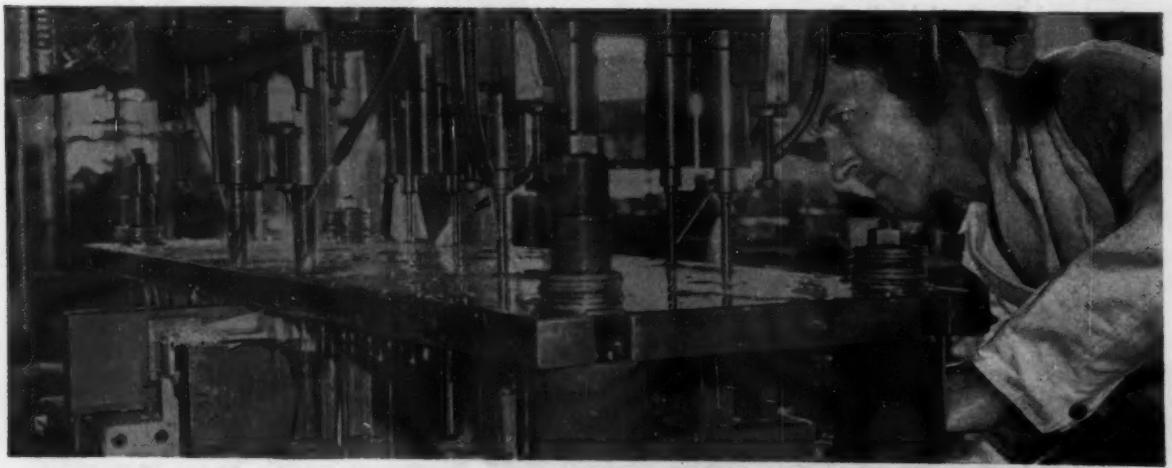
"... 20% more holes per grind"

"... Hole size tolerances of .0015" to .002" on smaller diameters"

"... More than 15% less downtime on our multiple-spindle drilling machines"

"... Less costly fixtures required"

By using Cincinnati SPIROPOINT® Drill Sharpener to apply the new *spiral point* geometry to standard twist drills, AMF reduces drilling costs right across the board—in time, tools, materials, maintenance.



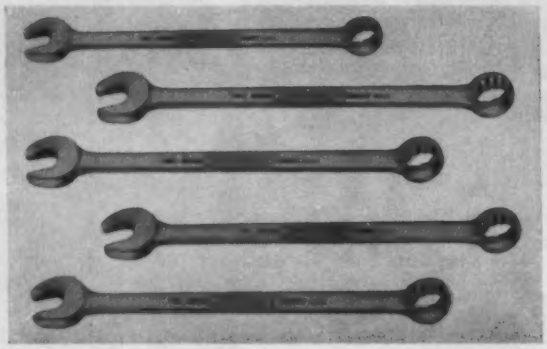
Ask your Cincinnati Lathe and Tool Dealer about SPIROPOINT— or write to us direct.

CINCINNATI LATHE AND TOOL CO.

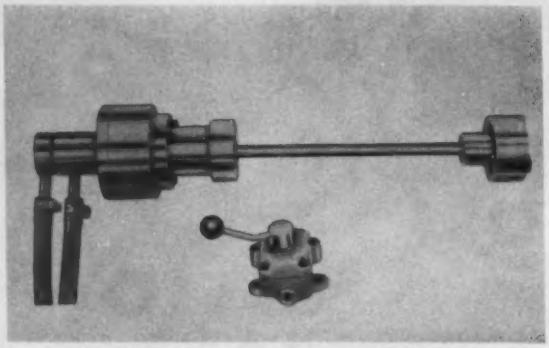
3207 Disney Street, Cincinnati 9, Ohio

"HYDRASHIFT" Lathes/"CINCINNATI" Drilling Machines/"SPIROPOINT" Drill Sharpeners

For more data circle this page number on card at back of book



Open end-box wrenches of larger size added to line made by J. H. Williams & Co.



Power chucking equipment for automatic screw machine made by Skinner Chuck Co.

Large Size Open End-Box Wrenches

J. H. Williams & Co., Buffalo, N. Y., has recently extended the size range of its line of open end-box wrenches with the addition of 1 11/16-, 1 3/4-, 1 13/16-, 1 7/8-, and 2-inch 12-point open sizes. These wrenches are said to have exceptional strength for their thin, slim jaws and handles. They are drop-forged from selected alloy steel, heat-treated, and chrome-plated over nickel.

Circle Item 619 on inquiry card

High-Production Drilling Unit

The first of a new line of hydraulically actuated units to be introduced by the John S. Barnes Corporation, Rockford, Ill., will be known as the "E.J.S. Junior." This unit is self-contained, of the quill type, with a thrust capacity of 600 pounds, and a stroke of 4 inches. It operates at 0 to 3000 cycles per hour and has spindle speeds ranging from 1200 rpm upward. The unit can be mounted in any position and can be furnished in a single-spindle design or with multiple-spindle head.

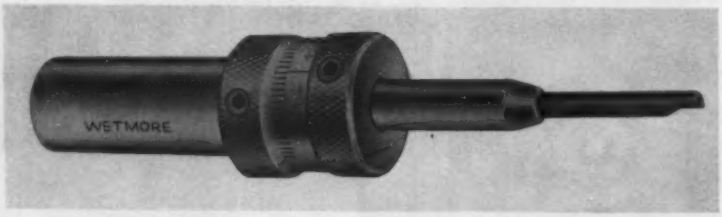
Illustrated is one of the initial prototypes tested by continuous production for over three years in a customer's plant. For this application, the unit was supplied with a two-spindle drill head and powered by a 1/2-hp motor.

Circle Item 620 on inquiry card

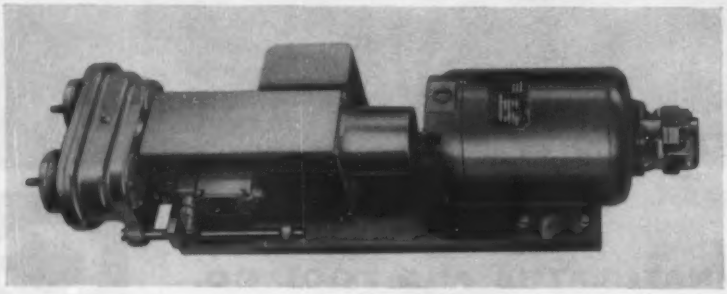
Power Chucking Unit

A power chucking unit brought out by the Skinner Chuck Co., New Britain, Conn., now makes it possible to convert Models 2 and 2G Brown & Sharpe automatic screw machines to air chucking. The addition of this unit to a B&S machine is said to make it possible to chuck cold-drawn and odd-shaped parts at higher speeds and at less cost. This power chucking equipment consists of a 4-inch air chuck with two or three jaws, soft blank work-holding top jaws, a threaded draw-bar, a rotating air cylinder, flexible air hose and fittings, a cylinder adapter, and a three-way control valve. The manufacturer claims that this unit can be installed in ninety minutes by any setup man. If greater production is desired, automatic feed hoppers, work ejectors, and automatic cam controls can be added to permit an operator to tend more than one machine.

Circle Item 621 on inquiry card



Wetmore "We-Bor" adjustable holder and carbide boring tool



Compact drilling unit introduced by the John S. Barnes Corporation

Carbide Boring Tools

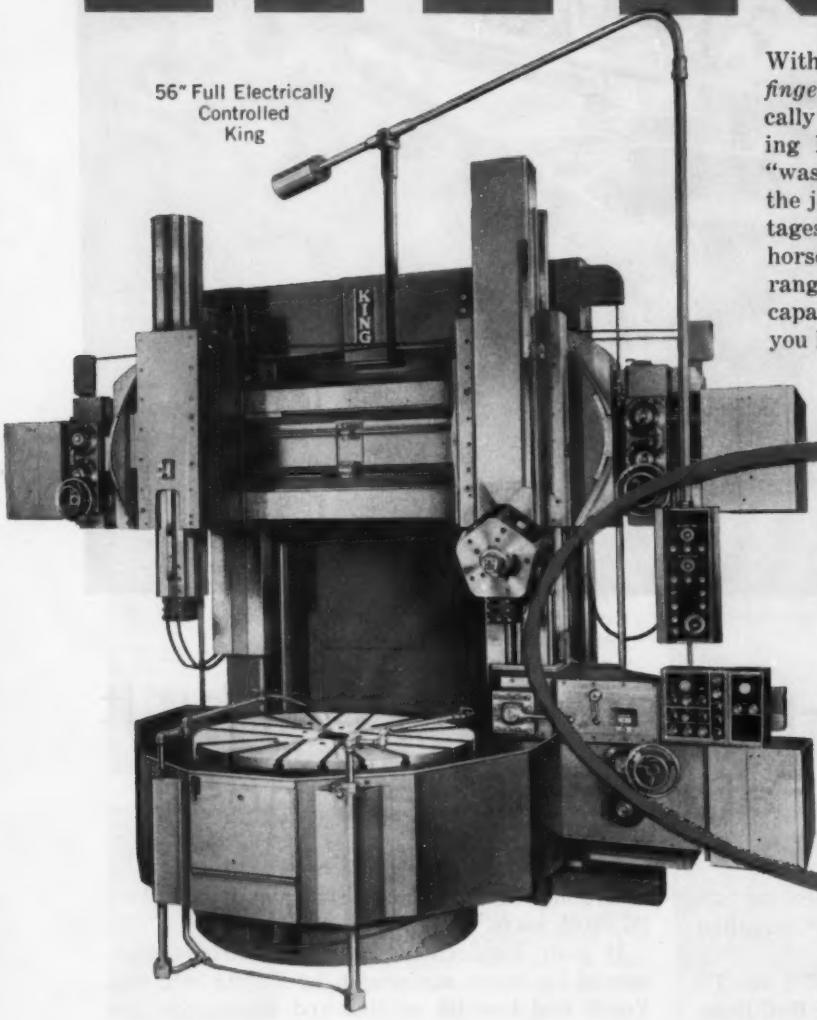
The Wetmore Tool & Engineering Co., Los Angeles, Calif., has announced a line of carbide boring tools designed for jig boring of holes ranging from 1/16 to 1 inch diameter at high surface speeds. These boring tools may be furnished in sets which include "We-Bor" adjustable holders, or they can be separately furnished for any boring tool-holders.

Circle Item 622 on inquiry card

You spend more time Actually Cutting Metal

WITH THE NEW **FULL ELECTRICALLY CONTROLLED**

KING



56" Full Electrically Controlled King

With all controls literally *at the operator's fingertips*, these new KING® Full Electrically Controlled Vertical Boring & Turning Machines eliminate costly operator "waste-motion" in setting up and running the job. Add to this King's design advantages of increased machine rigidity, higher horsepowers, expanded speed and feed ranges—giving you full advantage of the capabilities of modern cutting tools—and you have

the greatest productive capacity ever achieved for your vertical boring and turning work.

Here's what FULL ELECTRICAL CONTROL gives you—

Direction of Head Movements by simplified "up-down" and "in-out" switches right on the pendant

Pushbutton control of feed and rapid traverse of heads, and of rail raising and lowering

Pre-selective feed and speed selector dials, permitting operator to set the next feed or speed while a cut is being taken

24 feeds from .0016" to .250" and 24 spindle speeds

AND

Still MORE "Automation" is available with these optional added features—

Automatic Feed Stops . . . "Ultra-Matic"® Programming . . . Automatic Tracing Control of Heads . . . Power Indexing of Turrets

For further details on KING Full Electrically Controlled Machines—in sizes 30", 36", 46", 56" and up—see your authorized KING Distributor, or write us direct

AMERICAN STEEL FOUNDRIES, KING MACHINE TOOL DIVISION
1150 TENNESSEE AVENUE, CINCINNATI 29, OHIO

FORMULA FOR MMT=PE TOMORROW

KING Vertical Boring and Turning Machines

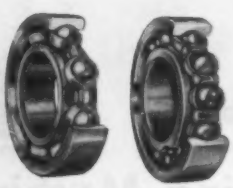
New Caterpillar D8 Series H Tractor

Performance-proved in big Cat-built Tractors...Fafnir Ball Bearings!

Where Caterpillar goes, Fafnir Ball Bearings go, too. They've helped carry the load in Caterpillar equipment for 39 years.

In the steering clutch of the new 23½ ton D8 Series H Tractor, for example, Fafnir Ball Bearings help provide easy, precise control. They are also used in the bulldozer cable control system, to insure smooth, dependable performance under brutal shock loads.

If your requirements call for bearings engineered for heavy equipment, let Fafnir help you. You'll find breadth of line and experience that assure precise answers. The Fafnir Bearing Company, New Britain, Connecticut.



In the Caterpillar D8 Tractor, Fafnir non-filling slot type ball bearings (left) take combined radial and heavy thrust loads, and filling-slot type bearings (right) take combined thrust and heavy radial loads. Both types are widely used in heavy equipment.

FAFNIR
BALL BEARINGS

For more data circle this page number on card at back of book

NEW CATALOGUES

• Yours for the asking. . . . Use postcard inside back cover

Removable Punches

Pivot Punch & Die Corporation, North Tonawanda, N. Y. Catalogue describing a new and different concept of retainers, called "Cone-Lock," with punches that can be pushed by hand into the retainer and removed with a pulling wrench while still in the press.

Circle **Item 501** on Inquiry Card

Belt Grinder

Sales Service Mfg. Co., St. Paul, Minn. Folder describing features of a "Tri-Matic" oscillating belt grinder. The work-head, conveyor, frame, and control cabinet are described, as well as the "aer-tronically" controlled belt oscillation.

Circle **Item 502** on Inquiry Card

Automatic Profiling

Pratt & Whitney Co., Inc., West Hartford, Conn. Circular No. 635, featuring Magnetrace automatic profiler, a compact and extremely accurate tracer-controlled milling machine. It is built from the base up for self-feeding, 360-degree profile milling.

Circle Item **503** on Inquiry Card

Tube Forming

Aeroquip Corporation, Jackson, Mich. Bulletin No. 25, covering engineering data on fabrication of "Tight Bend" tubes. It describes how these bends are formed through a cold-process method to extremely short radius bends of 1:1 ratio, or less.

Circle **Item 504** on Inquiry Card

Milling Cutters

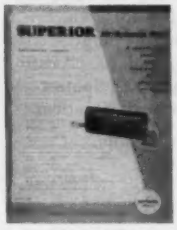
Aber Engineering Works Inc., Waterford, Wis. Bulletin 52-59, containing technical data on milling cutters, and featuring descriptions, illustrations, sizes and prices of various cutters. The descriptive matter offers helpful hints on time- and money-saving problems.

Circle **Item 505** on Inquiry Card

Variable-Speed Sheave

T. B. Wood's Sons Co., Chambersburg, Pa. Bulletin No. 6102, describing a stationary control "SVS" variable-speed sheave for standard V-belts. The patented, positive-locking "SVS" sheave is available with two, three, or four grooves.

Circle **Item 506** on Inquiry Card



Air/Hydraulic Feeds

Superior Controls (Superior Screw & Mfg. Co.), Crystal Lake, Ill. Leaflet describing smooth, fully controlled hydraulic feeds powered by your shop's own air supply. They are self-contained units requiring no pumps or motors and only a minimum of simple maintenance.

Circle **Item 507** on Inquiry Card

Welding Equipment

Linde Company, a division of Union Carbide Corporation, New York City. Catalogue describing the company's Heliarc manual welding equipment: torches, electrodes, argon gas, and argon-gas regulating equipment. Tables and optional accessories are included.

Circle **Item 508** on Inquiry Card

Electrodes

Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. 64-page booklet, "Electrode Pocket Guide," containing complete information on all types of electrodes available from Airco: mild steel, low alloy, low hydrogen, iron powder, etc.

Circle **Item 509** on Inquiry Card

Bolts

Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Catalogue featuring high-strength bolts for structural-steel connections. High-strength bolting offers the benefits of lower cost, permanent strength, less labor and equipment, and faster construction.

Circle **Item 510** on Inquiry Card

Presses

Federal Machine & Welder Co., Warren, Ohio. Bulletin No. 52131, illustrating and describing the Warco line of two- and four-point eccentric-gear presses in capacities from 100 to 1500 tons. Parts lists are included. The barrel type adjusting screw is used.

Circle **Item 511** on Inquiry Card

Grinding Wheel

American Emery Wheel Works, Red Bridge, Providence, R. I. Brochure describing a Duraflex dished-depressed center grinding wheel. It is intended as an aid to those with grinding-wheel problems and contains design characteristics and safety features.

Circle **Item 512** on Inquiry Card

• Yours for the asking. . . . Use postcard inside back cover

Isolators

Barry Controls Inc., Watertown, Mass. Leaflet describing the company's Series 670 and 297 isolators, which isolate shock, vibration, and noise caused by impact, rotating, and reciprocating machines. They lengthen equipment life by minimizing shock and vibration.

Circle **Item 513** on Inquiry Card

Blast Cleaning

Wheelabrator Corporation, Mishawaka, Ind. Bulletin 152-D entitled "The Facts In The Case For Cleaning Structurals," discussing the economic aspects of blast cleaning structural steel prior to use in commercial construction. Illustrated are techniques used.

Circle **Item 519** on Inquiry Card

Press Brakes

Niagara Machine & Tool Works, Buffalo, N. Y. 28-page Bulletin 89E, presenting the company's enlarged, modernized line of Series N press brakes. Described are design features, special work area provisions, typical forming and bending dies, etc.

Circle **Item 514** on Inquiry Card

Welders

Federal Machine & Welder Co., Warren, Ohio. Bulletin No. G-59, describing their portable resistance welders available for the metalworking industry. They can be adapted to high-production welding in spots where no other type could be used.

Circle **Item 520** on Inquiry Card

General Purpose Controls

General Electric Co., Schenectady, N. Y. Catalogue GEC-1260D, 72-page publication containing information on the complete line of control devices manufactured by the company's General Purpose Control Department. It includes complete product descriptions.

Circle **Item 515** on Inquiry Card

Cylinders

Hanna Engineering Works, Chicago, Ill. Brochure on "Powrmation" Series 1000 cylinders. Features include pressure-safe tube seals, one-piece steel heads with welded steel mountings, and a fast-change cartridge gland. Cylinders are for air and hydraulic uses.

Circle **Item 521** on Inquiry Card

Coolant Cleaning Equipment

Barnes Drill Co., Rockford, Ill. Bulletin No. 100, discussing the use of BarnesdriL Kleenall fabric filters and combination magnetic and fabric filters. Production savings are outlined, the operation of the equipment is explained, and applications are shown.

Circle **Item 516** on Inquiry Card

Circuit Breaker

General Electric Co., Plainville, Conn. Bulletin GEA-6759, giving complete information on the company's new low-impedance, rated 5 through 75 amperes, ALB-1C circuit breaker. It contains complete descriptive, dimensional, and ordering information.

Circle **Item 522** on Inquiry Card

Sump Filter

Arrow Tools, Inc., Chicago, Ill. Bulletin SFS-604, describing a sintered-metal hydraulic suction filter to protect hydraulic machinery and oil-recirculating equipment. The sump filter is made of sintered powdered metal, which provides depth of filtration.

Circle **Item 517** on Inquiry Card

Metal-Etching Control Material

Graphic Reproduction Sales Division, Eastman Kodak Co., Rochester, N. Y. Pamphlet No. P-36, presenting a control material for metalworking industries which employ etching, photomilling, or plating techniques. A bibliography on photo milling is included.

Circle **Item 523** on Inquiry Card

Predetermining Counters

Veeder-Root Inc., Hartford, Conn. Folder (Form 227773), describing and illustrating several of the major types of mechanical, electromagnetic, and photoelectric counters incorporating the predetermining feature. A wide variety of these counters is available.

Circle **Item 518** on Inquiry Card

Flame-Cutting Machine

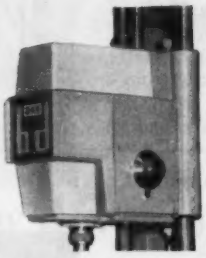
Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Catalogue Form ADC 899, describing the "Linagraph," latest addition to a line of flame-cutting machines. This machine is suitable for straight-line and shape cutting.

Circle **Item 524** on Inquiry Card

(This section continued on page 202)

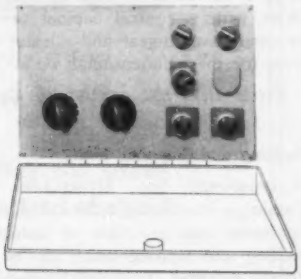
Here's Why Accurate Honing Is Easier On The New BarnesdriL Model 244...

Hone Feed — simple dial gives infinite adjustment.

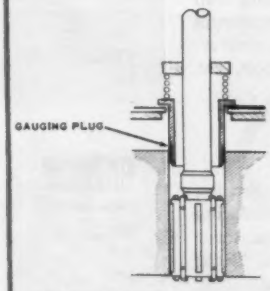


4-Speeds — turn of knob selects desired speed rate.

Reciprocation — length of stroke selected by convenient dial.

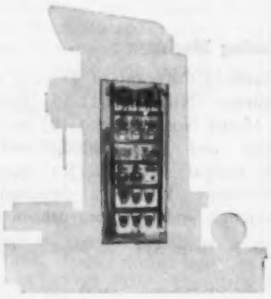


Set-Up — controls under lock and key.

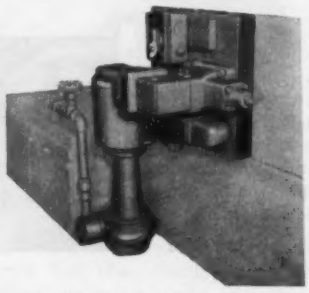


Plugmatic — automatic sizing assures accuracy within .0002".

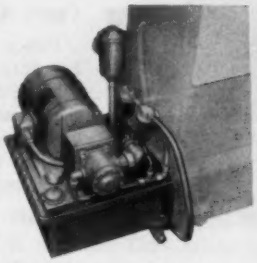
Operating Controls — mounted at shoulder height.



All Electric Controls — enclosed inside machine column.

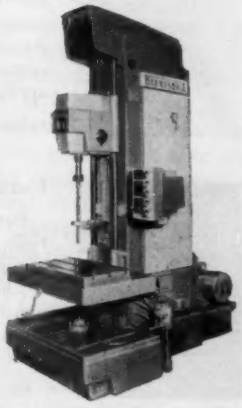


Coolant Pump and Hydraulic Valves — easily accessible.



Hydraulic Pump — in open, for easy maintenance.

BarnesdriL offers a completely new honing machine for high production honing of bores ½" to 6" in diameter. Large diameter applications depend upon amount of stock removal, bore length, and material. Machine is available with one or two spindles and a choice of three stroke lengths: 15", 25", or 40". For complete details see your BarnesdriL representative or write for new bulletin H-112 today!



BARNESDRIL HONING MACHINES

BARNES DRILL CO.

820 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 13121 Puritan Avenue

For more data circle this page number on card at back of book

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Shears

Verson Allsteel Press Co., Chicago, Ill. Bulletin (VHS-59) describing the company's line of hydraulic shears. These shears range in capacity from 8 feet of 3/8-inch mild steel to 12 feet of 1 1/2-inch mild steel. The bulletin shows typical models.

Circle **Item 525** on Inquiry Card

Mounted Wheels

Chicago Wheel & Mfg. Co., Chicago, Ill. Bulletin SS-101, describing the "SS Series" (Special Shapes) ordering system, which gets its name from six special or basic shapes. Research disclosed that they cover ninety per cent of portable grinding needs for mounted wheels.

Circle **Item 531** on Inquiry Card

Motor Reducers

Philadelphia Gear Corporation, Philadelphia, Pa. Catalogue entitled "Philadelphia Vertical Motoreducers and In-Line Reducers" (MR-58), dealing with motor reducers for use with equipment such as blowers, compressors, conveyors, cranes, hoists, machine tools, etc.

Circle **Item 526** on Inquiry Card

Automatic Milling

Marac Machinery Corporation, Yonkers, N. Y. Catalogue presenting a program-controlled milling machine. It is a standard, electrically run machine with a control cabinet housing necessary switch-gear and selector controls for three-dimensional work.

Circle **Item 532** on Inquiry Card

Shear Spinning Machines

Clearing Division, U. S. Industries, Inc., Chicago, Ill. Catalogue introducing an improved line of heavy-metal shear spinning machines, called the "Roto Forge." In addition to descriptive data, the principles and theory underlying shear-spinning metal flow are explained.

Circle **Item 527** on Inquiry Card

Drilling and Tapping Units

Hypneumat, Inc., Milwaukee, Wis. Catalogue containing technical data on operation and selection of automatic drilling and tapping units, air- or hydraulic-powered. This booklet also features the various uses to which these units can be adapted.

Circle **Item 533** on Inquiry Card

Chuck Actuator

Power Grip, Inc., Rockfall, Conn. Brochure describing a nonrotating air cylinder for operating air chucks. Design features include a hollow drawn tube, which replaces the solid drawbar; no limit on spindle speeds; no flywheel effect; minimum spindle overhang, etc.

Circle **Item 528** on Inquiry Card

Grinding Machines

Sheffield Corporation, Dayton, Ohio. Catalogue No. TFG-11-59, featuring the Model Nos. 101 and 103 precision thread- and form-grinding machines with typical Crushtrue(R) threading applications. Both are designed for production and toolroom use.

Circle **Item 534** on Inquiry Card

Welded Construction

Lincoln Electric Co., Cleveland, Ohio. Bulletin No. 1191.1, "Designer's Guide for Welded Construction," presenting some recent revisions in the Standard American Welding Society Symbols. It contains charts with information on the application of welding symbols.

Circle **Item 529** on Inquiry Card

Pumping System

Wesco Tool & Manufacturing, Burbank, Calif. Circular describing a unit (Model No. WP1021) consisting of a coolant pump, tank, and neoprene base, used primarily on jobs which circulate coolant liquids containing grit and abrasives.

Circle **Item 535** on Inquiry Card

Unitized Press Tools

Punch Products Corporation, Niagara Falls, N. Y. Catalogue B describing "Unipunch Series B" hole punching and notching units. It provides fully dimensional drawings of seven standard units for punching round and shaped holes up to 3.500 inches in diameter.

Circle **Item 530** on Inquiry Card

Punch Presses

Kenco Mfg. Co., Los Angeles, Calif. Bulletin describing a line of Kenco punch presses from 2 to 18 tons, including the Kenco "Electro Safe" punch presses, now offered in 5- to 18-ton models. "Cyclo Safe" roller clutch is available for all mechanical presses.

Circle **Item 536** on Inquiry Card

(This section continued on page 204)

R B&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By Fred E. Graves

Why cap screws instead of studs?

Many types of products once fastened with studs are today assembled with cap screws. Why the change in preference?

Studs show certain advantages in large diameters and in high temperature applications. But when it comes to smaller sizes used in tapped holes, designers and production people have found more advantages in cap screws.

ASSEMBLY FACTORS

In fastener selection for a given application, you have to consider production and assembly as well as joint strength.

Obviously, studs require two wrenchings (first stud, then nut). Also, there's a more expensive close tolerance tapping job, since a stud takes an interference fit to stay tight and not withdraw when nut is backed off.

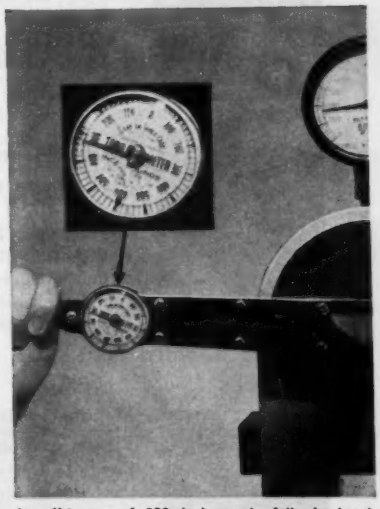
Cap screws require only a clearance fit. Used in a tapped casting, they can be repeatedly inserted and unscrewed without damage to threads.

HOW NOT TO USE STUDS

Studs are not meant to serve as dowels to locate and line up for fastening. To line up numerous studs and bring two pieces together raises assembly cost. Use dowel pins for alignment and use cap screws for fastening to achieve greater economy.

Screw develops high thread tension . . . and stays locked in place

RB&W TENSILOCK screw, despite the friction of the toothed flange, develops 4000 pounds tension with on-torque of 240 inch-pounds.



An off-torque of 330 inch-pounds fails to break loose the grip of the teeth. Tension is maintained by TENSILOCK screw.

Here is a locking fastener where the on-torque effort not only *anchors* the screw but also develops high preloading, or residual tension.

Like high tensile cap screws, RB&W's TENSILOCK* screws also give a high thread tension to torque ratio. But there's one important difference. The TENSILOCK fasteners lock with *teeth* as well as high residual tension.

RATCHET-LIKE LOCKING

Carburized teeth on flange of this one-piece fastener are so angled as to afford easy torquing. They bite into the seating surface when fastener is fully tightened. A circular groove in the flange increases flexing action and enables flange to maintain pressure on the imbedded teeth. To *loosen* a tightened TENSILOCK fastener thus takes much more effort than the on-torque. And it can be reused with little loss of this holding power.

FRICTION STOPS SLIPPAGE

The full clamping force exerted by these fasteners prevents slippage of the fastened members where lateral movement is possible because of large or eccentric holes. The positive gripping enables them to stay tight even under conditions of severe vibration or cyclic temperature fluctuations. RB&W TENSILOCK nuts also available. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, New York.

*Trademark Pat. applied for

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa., Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

For more data circle this page number on card at back of book

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Special Drill Jig Bushings

American Drill Bushing Co., Los Angeles, Calif. Catalogue describing "Thinwall" drill jig bushings (American Standard). Slip and fixed types and headless and head types are tabulated to show available lengths for drill sizes from No. 80 to 2 3/4 inches.

Circle **Item 537** on Inquiry Card

Drill Jig Bushings

American Drill Bushing Co., Los Angeles, Calif. Catalogue giving complete details and illustrations on how to select the correct size and type of drill jig bushings. A.S.A. Standard and American Standard types are described. Specifications and list prices are supplied.

Circle **Item 538** on Inquiry Card

Precision Instruments

Pic Design Corporation, East Rockaway, L. I., N. Y. 416-page 1960 Master catalogue No. 21, featuring precision instrument components. It contains technical details, MIL specifications and complete drawings of over 12,000 stock items—precision gears, shafts, etc.

Circle **Item 539** on Inquiry Card

Motorized Drive

Falk Corporation, Milwaukee, Wis. Brochure 3100.01, telling how the company has extended the "All-Motor Motoreducer" line by adding the Size 8E, thus increasing the range of applications for the line, especially in the lower speed ranges.

Circle **Item 540** on Inquiry Card

Presses

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Folder No. HS-1, describing the company's high-speed power presses. A press production chart is designed to help production engineers or plant managers determine how these units can boost efficiency.

Circle **Item 541** on Inquiry Card

Wet Abrasive Cutter

Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. Bulletin DH-260-R, describing the heavy-duty Campbell 406 wet abrasive "Cutamatic." It is an oscillating-wheel type of machine with hydraulic work clamps and wheel feed.

Circle **Item 542** on Inquiry Card

Heat-Treating

Ipsen Industries, Inc., Rockford, Ill. Catalogue reprint, "A Study of Temperature Uniformity in Heat Treating," discussing furnace design. It describes tests measuring temperature variations in the heating zone when a charge is loaded and brought to heat.

Circle **Item 543** on Inquiry Card

Tracer Control

True-Trace Corporation, El Monte, Calif. Bulletin No. SB-2, describing hydraulic tracer-control systems for 1, 2, and 3 dimensional applications on machine tools. New Synchro-Trace fully automatic, programmed 3D duplicating system is also described.

Circle **Item 544** on Inquiry Card

Springs

Lee Spring Co., a division of Leetronics, Inc., Brooklyn, N. Y. Catalogue listing over 750 different springs available for immediate shipment from stock. It contains complete engineering data on these springs. Those covered are both compression and extension.

Circle **Item 545** on Inquiry Card

Rust and Corrosion Control

Rust-Oleum Corporation, Evanston, Ill. Catalogue entitled "New Color Horizons" (Form 259), highlighting the Rust-Oleum New Color Horizons System that stops rust and beautifies with specially formulated primers and colorful top coatings.

Circle **Item 546** on Inquiry Card

Coil-Handling Equipment

Rowe Machinery & Mfg. Co., Inc., Dallas, Tex. Catalogue describing a line of automatic coil-handling equipment including coil cradles, straightening machines, cabinet feeds, roll feeds, coil buggies, conveyors and stackers, as well as reels (pull-off and actuator).

Circle **Item 547** on Inquiry Card

Shearing and Forming Machines

American Pullmax Co., Inc., Chicago, Ill. Folder describing "Pullmax," a line of universal shearing and forming machines. This equipment will cut straight edges or inside squares, circles and irregular shapes, as well as bead, joggle, edgebend, flange, slot-cut, etc.

Circle **Item 548** on Inquiry Card

ON PARTS LIKE THESE--- keep your costs DOWN with the NEW model B

CLEVELAND

On jobs that require turning and forming multiple diameters, shoulders and tapers, you can count on your Model B Cleveland Single Spindle Automatics to give you lowest machining costs. One end working tool can be mounted on the milling slide and, by adding hopper magazine, second operation work, such as threading other ends of studs, can be performed. In many cases, parts which otherwise would require multi-machine processing can be *made complete* on the highly versatile Cleveland.

The NEW Model B's are *faster*, too . . . with many design improvements and new features that give you new performance potential. They are fast-cycling, quick and easy to set up, fully automatic . . . ideally suited for both short and long run jobs.

Write for new bulletin, or call in the Cleveland Sales Engineer in your area.

New Model B Clevelands are built in 1⅝" and 2½" capacities; also available to handle 18" work lengths.

A of
armature shafts • arbors • pins • studs • transmission shafts • nipples • axles
and countless other similar parts — whether you need 50 pieces (sometimes even fewer), or thousands.

Here are some of the new features of this versatile and practical single spindle automatic:

Increased Spindle Speeds (up to 2017 on the 1⅝" machine) • Separate Feed Motor • Independent Front and Rear Cross Slides • Quick-set Stock Feed • Quick Change Collet and Feedshell Pads • Gusher Coolant Pump • Automatic Lubrication

EXTRA Accessories Include Cross Slide Turning Attachment, Hopper Magazine, Independent Cut-off Attachment, Automatic Bar Loader.

Remember, CLEVELANDS CUT COSTS!

Sales Offices: Chicago • Cleveland • Detroit • Hartford • Springfield, N. J.

CLEVELAND AUTOMATIC MACHINE COMPANY
4936 Beech Street • Cincinnati 12, Ohio

Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

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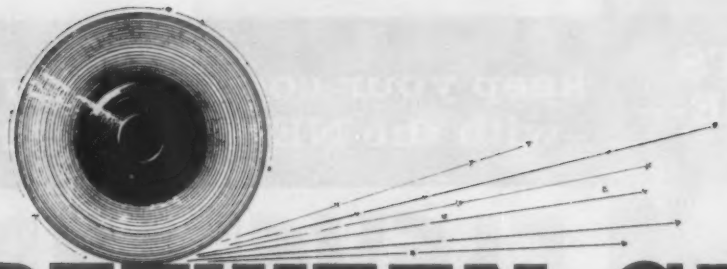


By E. S. Salichs

BETWEEN GRINDS

B & S in the Press

Over a year ago, the Brown & Sharpe Mfg. Co. organized an "Author's Club" to provide its employes with an incentive to write articles about design, production, operation, or maintenance of B & S products and processes. If an article submitted to the director of sales promotion is subsequently published in national media, the author becomes a member of the club and receives remuneration from the company, together with his membership card. Then there are periodic luncheons . . . pencils ready ?

What, No Wait

Containers for luggage that match the contour of cargo compartments in new jet aircraft are being made by the Hardman Tool & Engineering Co. Baggage will be removed from DC-8's in less than three minutes—faster than you yourself can deplane, that is, by using the conventional method of walking out.

Going, Going, Gone

Closed-circuit television as a method of auctioning off used machinery is now a trend. For example, Industrial Plants Corporation recently conducted an auction of used aircraft forging equipment from the Lynn, Mass., River Works of the General Electric Co. By using "Videotape" (a new electronic process), machinery can be demonstrated under power, hitherto an impossibility at auctions.

"Trick" Tag

License numbers that mean something special have, as we all know, long been used on automobiles. Now the practice is reaching the commercial airplane. For instance, Mechanical Air Controls, Inc., Detroit air valve manufacturer, carries the license number 311-MV on its twin-engine Cessna which is used in sales and customer service work. The 311 represents a popular model in the company's air valve line; the MV stands for MAC Valves, trade name of the company's products.

Good-Bye, Garden

The world's first jet-powered wheelbarrow is on a ninety-day tour of Europe, according to its producer, the AiResearch Mfg. Co. It is supplying power to start twin turbines of the Vertol 107 helicopter. So the wheelbarrow that used to carry earth now propels you off it. Hoe, hoe.

LUBE LAB—Miniature precision bearing being lubricated with a special filter-needle hypodermic prior to shipping from the new West Coast headquarters (Los Angeles, Calif.) of Miniature Precision Bearings, Inc. (Keene, N. H.). Resident engineer Robert Pierson appears at home in the sanitary "white room" laboratory as he clinically administers the dose—that's oil.

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA

Air-4 machines easily because of its lead content. Its low temperature heat-treatment means minimum distortion.

Another Report on AIR-4 TOOL STEEL:

"These clamping bars machined like a dream, and distortion was kept to a minimum."

The clamping bars above, of Bethlehem Air-4 tool steel, were made by Miller Tool and Die Company, Gloucester, N.J. John J. Nesbitt, Inc., Philadelphia, uses them for holding and expanding metal tubing. The dies, hardened to Rockwell C 57-58, were each machined from a piece of Air-4 1¾ in. thick, 3½ in. wide, and about 8 in. long. The over-all tolerances were plus or minus .002 in.

Easy to Machine, Low Distortion

According to our local tool steel distributor, Horace T. Potts Company, the customer reported that the machinability was "like a dream." And they were also delighted with the lack of distortion during heat-treatment—"best distortion-resisting grade we've ever used for this type of die."

Hardens in Air at 1550F

Air-4 is our new free-machining medium-alloy tool steel. It hardens in air at low temperature—about 1550F. It has excellent free-machining characteristics because of its addition of lead. Air-4 also has superior wear-resistance, high toughness, and deep-hardening properties, making it ideal for long tool life.

If you would like to have additional information about Air-4, get in touch with your Bethlehem tool steel distributor. Better still, order a trial bar and put it to work in your shop.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

The Direction of Grinding Marks Affects the Life of Tools

It might be well to take a good look at your tool-grinding practice, because it has been proved time and again that the direction of grinding marks has a direct bearing upon tool life. This is especially true with such tools as deep-drawing dies, and punches that have a moving contact with metals under high pressures.

No matter how fine or smooth the surface finish of ground tools may appear to be, don't be fooled—it actually has a saw-tooth contour. Material which moves parallel to the grinding marks shows much less tendency to "pick up," or adhere, than material moving across the grinding marks. But this "pick up" of material can't be permitted on such tools as drawing dies, where it's advantageous to grind in the same direction as the material moves. On some types of tools this kind of grinding is difficult, but the longer tool life justifies the effort. Punches which are ground longitudinally last much longer than those ground circumferentially, the most common method. Here also, longitudinal grinding is inconvenient, but worthwhile.

Although the direction of grinding on tools isn't given much thought in the average shop, it is often a big factor in getting the best possible tool life.

Send for TOOL STEEL LITERATURE

If you would like to receive booklets on Bethlehem tool steels, indicate your choice on this coupon, and mail to Room 1042, Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

- ☐ Hot Work
- ☐ High Speed
- ☐ Carbon and Carbon-Vanadium
- ☐ Shock Resisting
- ☐ Hollow Bar
- ☐ Oil and Air Hardening
- ☐ Special Purpose
- ☐ Lehigh H (High Carbon, High Chrome)
- ☐ Bearcat
- ☐ Tool Steel Selector

News OF THE INDUSTRY

California and Washington

MINIATURE PRECISION BEARINGS, INC., Keene, N. H., has opened a new western technical center and sales office, which will be located at 8621 S. Bellanca Ave., Los Angeles 45, Calif. The new center will be headed by HARRY E. GABRIEL, newly appointed western manager of MPB. ROBERT R. PIERSON will be in charge of the laboratory which will offer complete bearing evaluation and analysis, cleaning, and lubrication. RAYMOND G. SPARKS and EARLE OLSON, sales engineers, will service MPB customers on the West Coast.

CONRAD KUNZE has been appointed assistant manager, operations, for the CONVAIR (San Diego) Division of General Dynamics Corporation, San Diego, Calif. Mr. Kunze will be in charge of manufacturing, tooling, manufacturing development and process specifications, quality control, and plant engineering for the San Diego division.

WILLIAM M. HARKNESS will assume the newly created post of plant engineer for the Santa Clara, Calif., plant of NORTON CO., Worcester, Mass., about January 20.

E. W. BLISS CO., Canton, Ohio, has named HARRY A. SKILLMAN as West Coast manager of the Press and Die Supply Divisions, and MILTON J. JEFFERIS as factory manager. At the same time, the company announced the transfer of manufacturing operations from a leased facility at San Jose to a company-owned plant in the City of Industry area of Los Angeles. Both Mr. Skillman and Mr. Jefferis will be located at this new Bliss manufacturing facility, 13280 East Temple Ave., City of Industry, Calif.

JOSEPH T. RYERSON & SON, INC., Seattle, Wash., announces the addition of Reynolds aluminum to its steel service center stocks. The new aluminum stocks include rod, bar, sheet, plate, and structural shapes. Service is also being given on commercial building products consisting of aluminum roofing, siding, roof deck, insulated wall panels, building sheet, and aluminum sheet for duct work.

Illinois and Wisconsin

ROCKFORD MACHINE TOOL CO., Rockford, Ill., announces the election of the following new executive officers: HARRY B. NEWTON, chairman of the board; KENNETH M. ALLEN, president; ROBERT C. CHRISTENSON, vice-president and secretary; and HOWARD H. SWENSON, assistant secretary.

AMERICAN STEEL FOUNDRIES, Chicago, Ill., announces that JOHN F. PROBST has been elected president of South Bend Lathe, Inc., a subsidiary of American Steel Foundries. Mr. Probst will succeed RUSSEL E. FRUSHOUR, who is retiring. Mr. Frushour will remain a director as well as a consultant. Mr. Probst is also a director of the company. RICHARD S. ANDERSON will become secretary-treasurer of South Bend Lathe. He replaces MAURICE HOWARD, who is retiring.

John F. Probst, president, South Bend Lathe, Inc.

(Left) Harry A. Skillman, West Coast manager, and (right) Milton J. Jefferis, factory manager, Press and Die Supply Divisions, E. W. Bliss Co.

Michigan

THOMAS J. BECKER has been appointed vice-president of SURVEY ENGINEERING CORPORATION, Detroit, Mich.

NATIONAL BROACH & MACHINE CO., Detroit, Mich., announces the appointment of FRANK KIRSTEN as factory manager and CARL MOTZ as chief engineer.

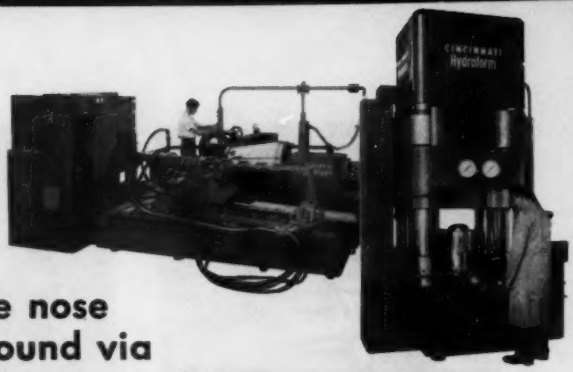
HUPP CORPORATION, Cleveland, Ohio, has acquired the assets of JOHN J. FANNON PRODUCTS CO. and JOHN J. FANNON & CO., Detroit, Mich. The acquisitions will be operated as a wholly owned subsidiary of Hupp Corporation, with JOHN J. FANNON, JR., as president and ROBERT J. FANNON as vice-president. Headquarters of the new subsidiary will remain in Detroit.

DEVLIEG MACHINE CO., Royal Oak, Mich., announces that C. B. DEVLIEG has been named chairman

Fig. 2

Fig. 2, above. Sonic measurement of finished Hydrospun Nike Hercules nose cones. Thickness of the tapered wall is held to ± .006". Photos and data courtesy of Lycoming Div., Avco Corp., Stratford, Conn.

Cincinnati® Hydroform® machines are built in 8", 12", 19", 23", 26" and 32" sizes; Hydrospin® machines are built in a variety of styles and sizes to meet your production requirements.



Another missile nose gets off the ground via

CINCINNATI Hydroform/Hydrospin!

NIKE HERCULES NOSE CONES are in quantity production at Lycoming (Stratford) Div., Avco Corporation, subcontractor to Douglas Aircraft Co., Inc., Charlotte Div., for these missile components. The success of this work is due to the unique capabilities of Cincinnati Hydroform and Hydrospin machines to form the nose cone to the desired contours and to the degree of precision required.

In the foreground of Fig. 1, below, are shown the five work stages to produce the finished part. "A" is the 17" dia. blank of ½" thick, annealed 6061 aluminum, which is preformed by a Cincinnati Hydroform to the shape shown at "B". Parts "C", "D" and "E" represent the nose cone shape progression through three passes on a Cincinnati Hydrospin. Wall section of the final shape is tapered from .078" at the nose to .125" at the aft end, with wall thickness controlled by the Hydrospin to ± .006". The metal of the finished part is solution heat treated to a T6 condition.

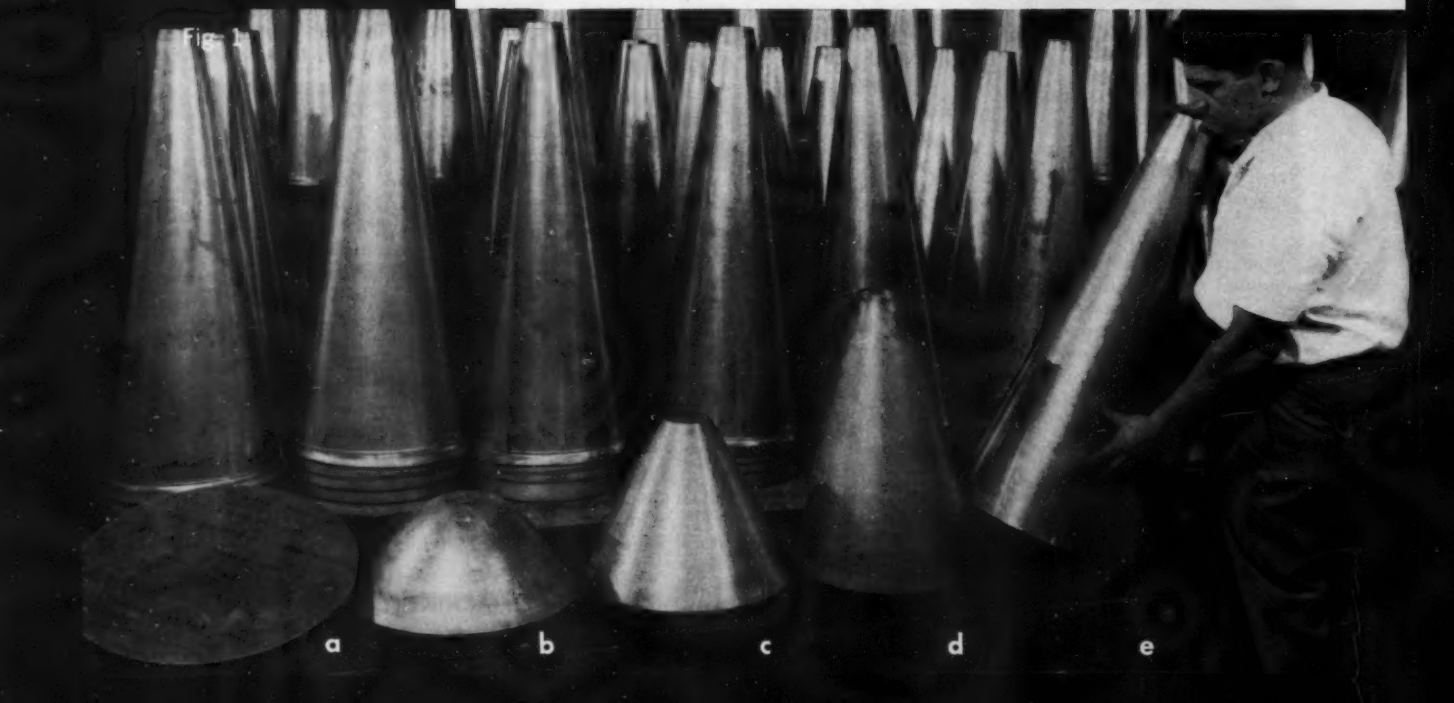
This winning Hydroform-Hydrospin combination is aiding missile and many other component parts manufacturers to produce formerly difficult or impossible sheet metal shapes to specified tolerances . . . while producing major savings in *time*, *tooling*, *labor* and *material costs* as well. Look into the many advantages of Hydroforming and Hydrospinning. Call in a Meta-Dynamics Division field engineer for full details.

Hydroform/Hydrospin
META-DYNAMICS DIVISION
Machines for Metal Forming and Heat Treating

THE CINCINNATI MILLING MACHINE CO.
Cincinnati 9, Ohio, U.S.A.

CINCINNATI

Fig. 1



(Left) C. B. DeVlieg, chairman, board of directors, and (right) C. R. DeVlieg, president, DeVlieg Machine Co.

of the board of directors. He previously served as president. C. R. DeVlieg, formerly executive vice-president, has been named president. Richard A. Jerue is now vice-president in charge of engineering for the company, and Allen N. Sweeney, chief engineer of the Microbore Division, has been named director of engineering and research.

Robert W. Militzer, chief engineer, Micromatic Hone Corporation

Robert W. Militzer has been appointed chief engineer of Micromatic Hone Corporation, Detroit, Mich. Prior to his promotion, Mr. Militzer was supervisor of mechanical engineering at Micromatic. John H. Greening has been appointed director of engineering.

New England

Torrington Mfg. Co., Torrington, Conn., announces that Erman V. Cavagnero and Werner Vogt have been promoted to new engineering positions in the Machine Division. As chief design engineer, Mr. Cavagnero will supervise the design of mill machinery, spring coilers, torsion winders, four-slides, and other products. As chief development engineer, Mr. Vogt will be in charge of advanced planning for wire and strip forming equipment, and the application of existing products.

B. C. Ames Co., Waltham, Mass., announces the appointment of Paton & Meegan, 138 Silver Lane, East Hartford, Conn., as its representatives in the state of Connecticut. Paton & Meegan have offices in East Hartford, the Bridgeport-New Haven area, and in Glastonbury. Telephone numbers are as follows—East Hartford, BUtler 9-4654; Bridgeport-New Haven, TRinity 4-2334; and Glastonbury, MEdford 3-1915. Phillip Thompson has joined Paton & Meegan as a junior partner.

Torrington Co., Torrington, Conn., announces the assignment of district engineers to four Torrington regional sales offices. Richard Finn joins the company's office at 125 W. 3rd St., Tulsa, Okla. Harvey M. Mauel has been assigned to the office at 475 White Plains Road, Eastchester, N. Y. Robert F. Deacon is joining the Torrington office at 666 Washington Road, Pittsburgh, Pa. John W. Stout has been assigned to the Torrington office at 6900 Castor Ave., Philadelphia, Pa.

Edward W. (Ted) Raineault has been appointed district manager of the eastern territory of Cleveland Automatic Machine Co., Cincinnati, Ohio. This territory includes the six New England states and eastern New York State. His headquarters will be in the Hartford, Conn., office at 119 Ann St. He succeeds former district manager Russell A. Hanna, recently deceased.

Fafnir Bearing Co., New Britain, Conn., has announced plans to double the size of its nearby Newington plant to increase capacity and reduce costs. The addition should be ready for occupancy by late fall.

Warner & Swasey Co., Cleveland, Ohio, has acquired a substantial interest in Wang Laboratories, Inc., Natick, Mass. Wang Laboratories develops and manufactures a variety of specialized electrical and electronic devices and components, some of which are used on machine tools built by Warner & Swasey. It was founded by An Wang, a native of China, who as a young electrical engineer was sent by the Chinese Nationalist Government to study in the United States.

Norton Co., Worcester, Mass., announces that Robert V. George and Edwin R. Larson have been appointed field engineers and Roderick L. Smith has been named a district sales engineer. Mr. George will be located in the company's Detroit district. Mr. Larson will be located in the San Francisco Bay area of the company's West Coast district. Mr. Smith will work in the Indianapolis, Ind., district.

Morse Twist Drill & Machine Co., New Bedford, Mass., announces that Frank E. Olson will cover sales activity in the Baltimore-Virginia area for the firm. The Morse Co., a division of Van Norman Industries, Inc., also announced the appointment of David L. Topp and Ralph A. Wilkins to its sales force.

Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence, R. I., announces the following appointments: Henry A. Szostek, district manager for the North Central district; Gottlieb R. Mohn, district manager for the Midwest district; Jack Petersen, district sales manager for the West Coast district; Colin Sharp, service manager for the West Coast district; Dimitry Yasinczuk, supervisor of the inside sales department; Irving Rollins, supervisor of the stock room and shipping departments; Frank Jabin, supervisor of order processing; Albert Cummings and Joseph Mori, inside salesmen. The following outside sales engineers will join the Cutting Tool Division: Richard A. Bor-

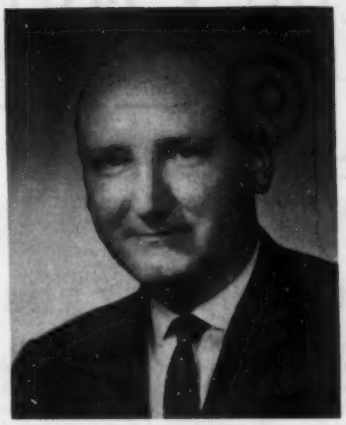
JESON in the Midwest district; GORDON F. PACKER in the West Coast district; ROBERT W. KENNY, JR., JOHN MCALEESE, STUART E. JENCKS, and EDWARD A. CHACE in the Northeast district.

ROBERT R. RHODEHAMEL has been appointed general manager of CONE AUTOMATIC MACHINE CO., INC., Windsor, Vt. A veteran of many years in the metalworking industry,

Robert R. Rhodehamel, newly appointed general manager, Cone Automatic Machine Co., Inc.

Mr. Rhodehamel has specialized in multiple-spindle automatic bar and chucking machines.

GEORGE P. BURNS has been elected vice-president and sales manager—machine tools for the VAN NORMAN MACHINE CO., Springfield, Mass. Mr. Burns joined Van Norman twenty years ago as a turret lathe operator. He moved into the sales



George P. Burns, vice-president and sales manager—machine tools, Van Norman Machine Co.

and service field when he was named service manager in 1952.

New York

NIAGARA MACHINE & TOOL WORKS, Buffalo, N. Y., announces that EDWIN A. MUNSCHAUER, JR., has been named director of research, and H. STANTON CHEYNEY, service manager. In addition to his new responsibilities, Mr. Munschauer will continue as treasurer of the company and as a director.

WILLIAM W. SORN has been appointed manager of manufacturing at LIPE-ROLLWAY CORPORATION, Syracuse, N. Y.

RAY A. YOUNG has been appointed general sales manager of SENECA FALLS MACHINE CO., Seneca Falls, N. Y. Mr. Young will make his headquarters at the home office of the company in Seneca Falls.

Ohio

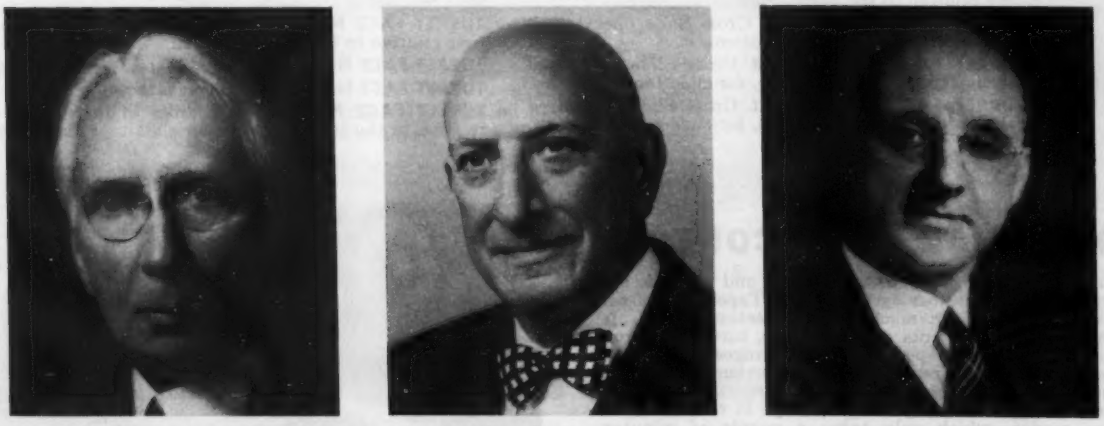
EATON MFG. CO., Cleveland, Ohio, announced that its wholly owned subsidiary, the Cleveland Worm & Gear Co., and the latter's

George H. Acker, general manager of Cleveland Worm & Gear Co. and Farval Corporation, divisions of the Eaton Mfg. Co.

subsidiary, the Farval Corporation, have become divisions of Eaton under their present respective names. At the same time, GEORGE H. ACKER, president of Cleveland Worm & Gear and Farval, has been appointed general manager of the two divisions.

AMERICAN TOOL WORKS CO., Cincinnati, Ohio, announces some major changes in the top personnel of the firm. JAMES BURTON DOAN and J. COLEMAN HUSSEY, SR., have retired.

(Continued on page 214)



(Left) James Burton Doan and (center) J. Coleman Hussey, Sr., who have retired as chairman of the company and vice-president, respectively; and (right) Robert S. Alter, board chairman, American Tool Works Co.

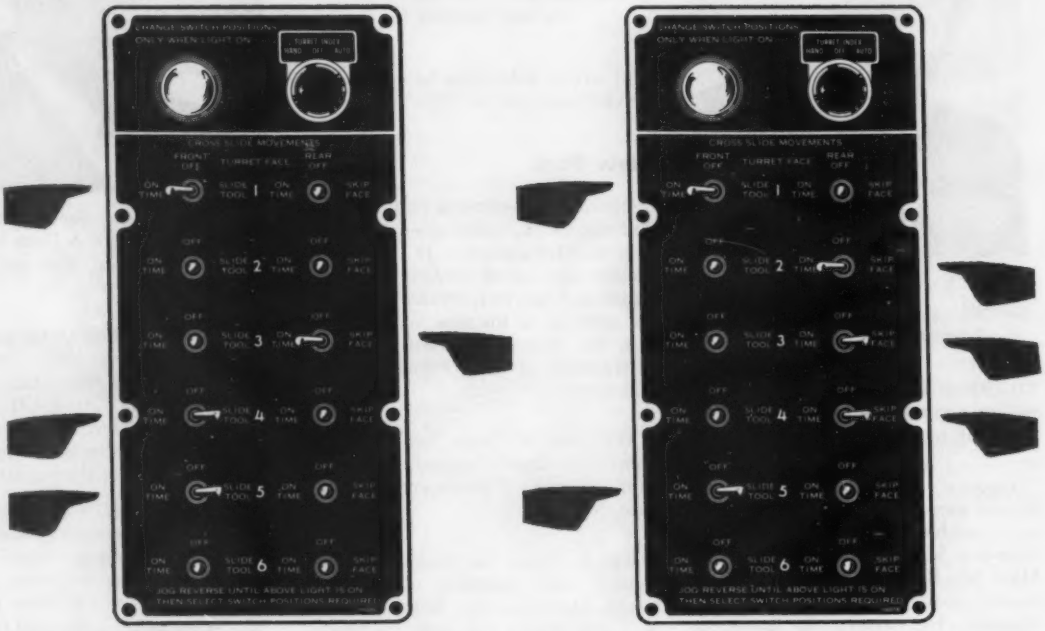
P&J means Profitable Jobs...

...RE-EQUIP WITH A

AN ALL-NEW MACHINE . . . WITH ALL THE

NEW SELECTOR SWITCH CROSS SLIDE CONTROL

This new control system lets you set all cross slide movements by merely operating selector switches. There are no covers to remove or replace, no pins or rolls to relocate. Setup is much faster and easier . . . programming is much more flexible. Front and back slides can be set for on-time or delayed motion relative to the turret movement—without *any* restriction to the sequence pattern. Both slides can be operated together or independently with any turret face and can be adjusted longitudinally, independent of each other.



TURRET FACE No. 1—Front Cross Slide operates *on time* relative to the turret motion.
TURRET FACE No. 3—Rear Cross Slide operates *on time* relative to the turret motion.
TURRET FACE No. 4—Front Cross Slide is *delayed* relative to the turret motion, for slide tool operation.
TURRET FACE No. 5—Front Cross Slide is *delayed* relative to the turret motion, for slide tool operation.

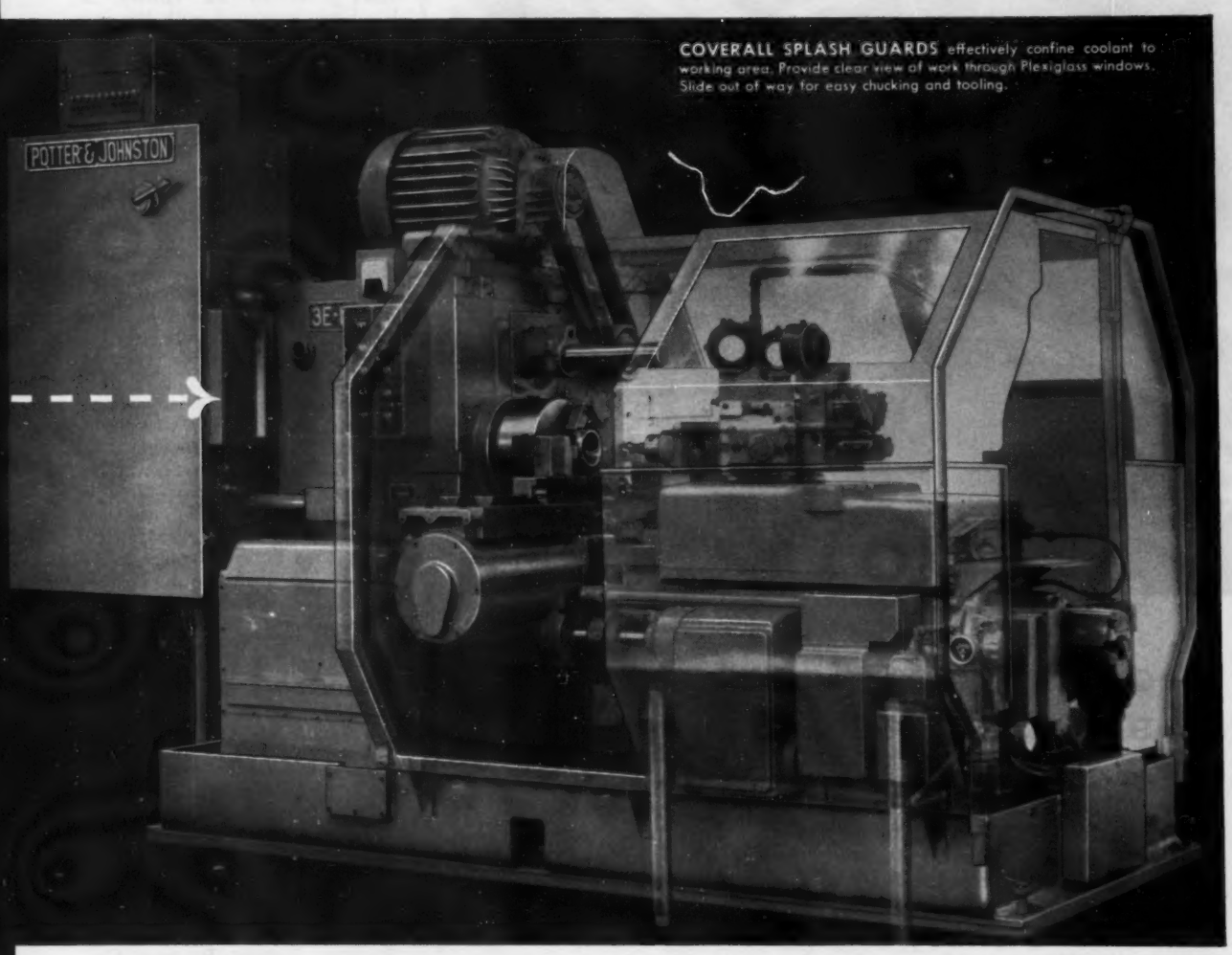
TURRET FACE No. 1—Front Cross Slide operates *on time* relative to the turret motion.
TURRET FACE No. 2—Rear Cross Slide operates *on time* relative to the turret motion.
TURRET FACE No. 3—Skip turret face.
TURRET FACE No. 4—Skip turret face
TURRET FACE No. 5—Front Cross Slide is *delayed* relative to the turret motion, for slide tool operation.

OPTIONAL TAPE CONTROL

Simple in design, easy to understand and operate, and priced far below other systems, P&J Tape Control can save up to 25% in machining and setup time. Tape controls all movements of the spindle, turret and cross slides, including all speed and feed changes. Tape preparation for the average job takes less than 30 minutes and requires no technical knowledge. Programming setup time is eliminated by placing the tape in the machine's tape reader—which only takes a couple of minutes. Optimum programming is assured, with parts machined in minimum time.

3E-15 Automatic

ADVANCED-DESIGN FEATURES YOU'RE LOOKING FOR!


COVERALL SPLASH GUARDS effectively confine coolant to working area. Provide clear view of work through Plexiglass windows. Slide out of way for easy chucking and tooling.
POTTER & JOHNSTON

The Potter & Johnston 3E-15 Automatic Turret Lathe is a truly new machine from the base up—*not* just an old model with a "face-lifting!" In addition to Selector Switch Cross Slide Control and Optional Tape Control, this machine also offers many other important new design and construction features, including: A new 15 hp headstock, with power to spare for fast metal removal with carbide tooling; greater rigidity throughout for faster roughing and more accurate finishing; "Control Zone" operation for faster, easier, more convenient setup and machining; separate drive for turret indexing for faster, easier setup; self-adjusting electric clutches that never require maintenance; a central, automatic lube system with single point fill; and a 6-face turret that allows more cuts per automatic machining cycle.

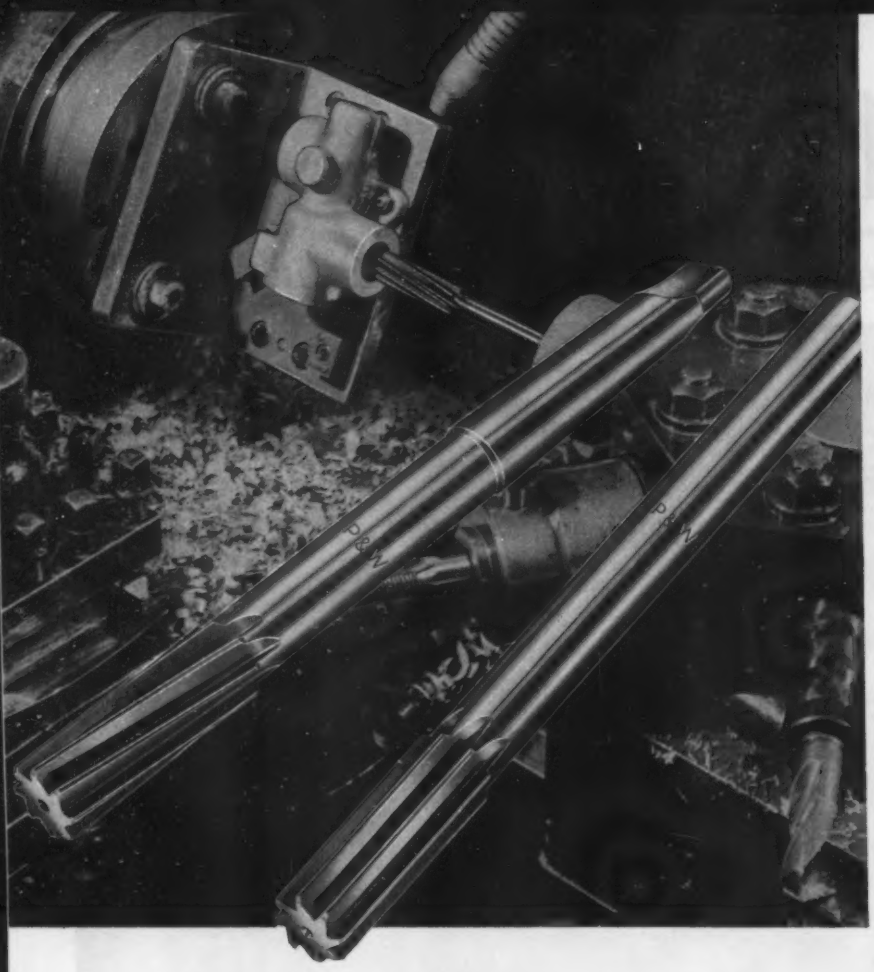
ON-THE-JOB PERFORMANCE . . . has already proved the ability of the P&J 3E-15 to cut machining time and costs. For a complete description of all the 3E-15 features, send now for your free copy of Circular No. 177 Pratt & Whitney Company, Inc., 12 Charter Oak Boulevard, West Hartford, Connecticut.

100th Anniversary 1860 P&W 1960

PRATT & WHITNEY®

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS



QUALITY COSTS LESS,
BECAUSE IT PRODUCES MORE!

Pratt & Whitney Reamers stay on the job longer . . . produce more smooth, round, accurate holes per tool. Correctly designed, carefully manufactured from selected steels, expertly heat treated and given an exclusive surface treatment, they're *quality all the way.* Investing in the finest will save you *dollars* in the long run.

Pratt & Whitney produces reamers for every industrial application. You can select standard types and sizes from on-the-shelf stocks at the P&W Branch Office near you; non-standard sizes are quickly ground and delivered from stocks of hardened blanks. Write now for complete information. Pratt & Whitney Company, Inc., 12 Charter Oak Blvd., West Hartford, Conn.

. . . MILLING CUTTERS • CUT-OFF BLADES • END MILLS • KELLER CUTTERS • KELLERFLEX BURS . . .

100th Anniversary 1860 1960

PRATT & WHITNEY
FIRST CHOICE FOR ACCURACY
MACHINE TOOLS • GAGES • CUTTING TOOLS

Mr. Doan rose from office boy to chairman of the firm. He came to American Tool Works when the firm was "Lodge & Davis" on September 1, 1887. During World War I Mr. Doan was president of the National Machine Tool Builders Association, which he had helped to found some years previously. Mr. Hussey, Sr., has been associated with the company for fifty years. He was vice-president and domestic sales manager. The new board chairman will be ROBERT S. ALTER, who had been executive vice-president and foreign sales manager. JOHN C. HUSSEY, JR., will be the new sales manager, with GLENN R. KRAUS as assistant sales manager.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, announces four changes in the field organization representing Parker-Hannifin industrial pneumatic and hydraulic system components. D. G. (DAVE) HENDERSON, sales engineer in Pittsburgh, is promoted to regional sales manager for southern California with headquarters at the Parker-Hannifin sales office, 5827 W. Century Blvd., Los Angeles 45. C. A. (CLEM) STORCH, sales engineer in the Chicago office, is transferred to succeed Mr. Henderson in the Pittsburgh office at 300 Mt. Lebanon Blvd. ROY E. POWERS is transferred from Detroit to the southern Ohio territory, with headquarters in the Mariemont Center Building, Cincinnati. ROBERT O. MCCARVILLE is new sales engineer for the Chicago office at 500 S. Wolf Road, Des Plaines, Ill.

CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio, announces that R. G. BIRKIN has been appointed sales manager of its Heavy Machinery Division. He replaces C. H. SAITER, who is retiring from active service but will continue as a consultant for special projects.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces that HENRY A. TOBEY has been elected vice-president in charge of manufacturing of its Bearing and Rock Bit Division. Mr. Tobey joined the Metallurgical Department of the Timken Co. in 1928, and eventually was made general factory manager in 1958. RALPH W. UPDEGRAFF was appointed to the post of general factory manager, Bearing and Rock Bit Division of the company, and ROBERT L. SISSON, general superintendent of the Canton and Gambrinus Bearing Factories. Three promotions were made at the Canton and Gambrinus Bearing Plants. JOSEPH L. DUZAN has been appointed assistant to

(Continued on page 218)

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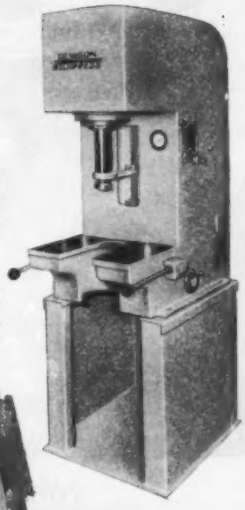
DENISON HydrOILics

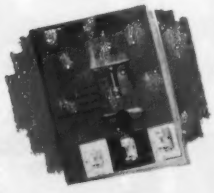
7 major advanced features—
in new cost-reducing series
of DENISON "R-S-T"
hydraulic bench presses

NEW PRESS



NEW "R-S-T" SERIES MULTIPRESS . . . versatile cost-reduction tool on small lots or high production runs. Standard accessories available to increase productive capacity.

FREE BULLETIN . . . write for your copy of our 8-page specification and application Bulletin 324.



NEW PRESS series is designed to cut costs on your toughest production jobs. Here are the key advantages built into this new, ultra-efficient line of presses.

Produces more pieces-per-hour . . . 65% faster approach. Faster return speeds on the hydraulic ram give you more cycles-per-minute.

Simpler to tool . . . there's more daylight to mount tools for manual or automatic production.

Faster to set-up . . . new, quick, simple adjustment now sets position of ram in seconds. And you can "inch" the ram to the work under set pressure. Closer control of ram pressure is quickly attained with a newly-developed relief valve.

Handles wider range of work . . . ram stroke has been doubled for greater tool clearance for long, deep work.

Easier to operate . . . there's more knee room for operator convenience.

Simpler to maintain . . . complete motor and pump swing out of position to inspect and service the hydraulic system.

Built to J. I. C. standards

Your nearby Denison Production Specialist can give you *all* of the details.

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
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HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC MULTIPRESS

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EXPERIENCE

CONTOUR MILLING MACHINES

POSITIONING TABLES

VERTICAL TURRET LATHES

to help you into tape

from the people who developed the first commercially available tape-controlled machine tool

While there is a profitable place for numerical control in nearly every plant, the final decision to go into tape depends upon a number of economic and manufacturing considerations. You can come with confidence to Giddings & Lewis to discuss these considerations.

Giddings & Lewis pioneered tape-controlled machine tools . . . has produced more major machines with numerical control than any other builder . . . has developed its own control systems . . . uses tape-controlled machines extensively in its own shops . . . and has established a numerical control research, development, testing, and programming center unique in the industry.

Giddings & Lewis machine tools are available with G&L Numeripath* magnetic tape continuous-path control or G&L Numeripoint* punched tape discrete positioning control, as well as with other makes of control systems. These machines are specifically designed and manufactured to be operated under tape.

For experienced answers to your tape-control questions, consult your Giddings & Lewis distributor or the factory. Literature available upon request.

*Trade-marks

FIRST tape-controlled contour milling machine.

FIRST tape-controlled vertical boring mill.

FIRST tape-controlled vertical turret lathe.

FIRST tape-controlled die sinking machine.

FIRST tape-controlled horizontal boring, drilling, and milling machine.

FIRST machine tool builder to develop and manufacture its own numerical controls.

FIRST and only builder to provide programming and magnetic tape preparation service for customers.

FIRST builder to offer both path and point control.

FIRST builder to use tape-controlled machine tools in its own shops.

GIDDINGS & LEWIS MACHINE TOOL COMPANY, FOND DU LAC, WISCONSIN

GIDDINGS & LEWIS

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Leader in tape-controlled machine tools

FLOOR TYPE HORIZONTALS

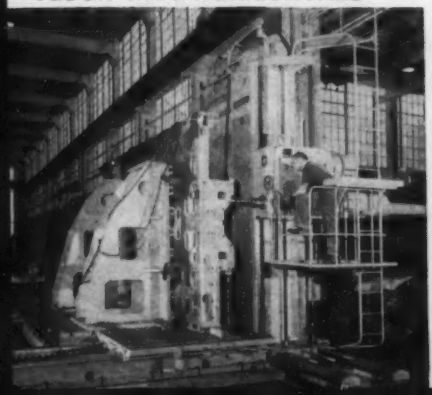
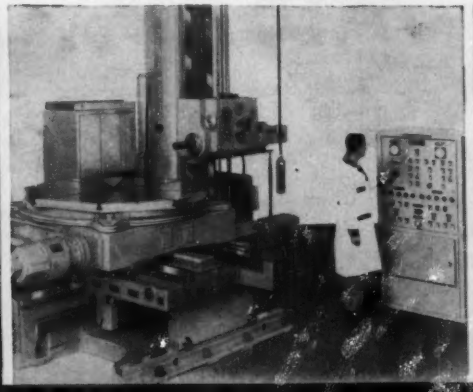
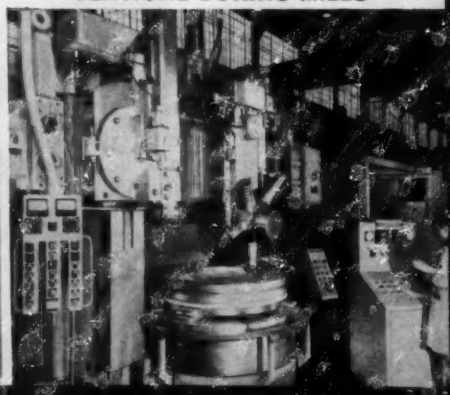


TABLE TYPE HORIZONTALS



VERTICAL BORING MILLS



the general factory manager–Bearing and Rock Bit Division, JAMES E. O'CONNOR was promoted to superintendent of the Gambrinus Bearing Factory, and ROBERT M. DUFFIELD, promoted to general foreman of the Department 62 Machining Operations of the Gambrinus Factory.

NATIONAL MALLEABLE & STEEL CASTINGS CO., Cleveland, Ohio, announces that JOHN F. TORLEY has been appointed vice-president–manufacturing of the company's Industrial Division in Cleveland. He has been manager of the company's Chicago Works. WILLIAM JOST, JR., replaces Mr. Torley as manager of the Chicago Works, having been appointed general superintendent earlier this year.

Pennsylvania, Maryland, and District of Columbia

BALDWIN-LIMA-HAMILTON CORPORATION, Philadelphia, Pa., announced the formation of a new manufacturing division at Eddystone, Pa. To be called the Industrial Equipment Division, the organization will be headed by FREDERICK A. FIELDER, B-L-H vice-president, who has been named general manager of the new division. It will continue to manufacture all of the products formerly made by the Eddystone Division, and certain of the product lines previously made at the B-L-H Hamilton Division, Hamilton, Ohio, as well as Loewy-Hydropress products. PERRY W. WHITE, a vice-president of the corporation and a member of the board of directors, who has been general manager of the Eddystone Division, will move to the corporate offices in Philadelphia.

BIRDSBORO STEEL FOUNDRY & MACHINE CO., Birdsboro, Pa., has changed its name to the BIRDSBORO CORPORATION. According to President G. Clymer Brooke, the new name adequately embraces the entire line of manufacture of the company and will enable it to continue diversifying and expanding under a nonrestrictive company name.

RUSSELL O. NEWTON has joined the ERIE FOUNDRY CO., Erie, Pa., as sales manager.

GAYLON D. ROBINSON joined PANGBORN CORPORATION, Hagerstown, Md., as abrasive sales engineer for the Chicago district.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has established a new district office in Washington, D. C. WILLIAM P. DOUGLAS, field welding engineer for the company, has been named the district manager.

Canada

CHARLES CHURCHILL (CANADA) LTD., Toronto, Canada, is now exclusive representative in Canada for the HEALD MACHINE CO., Worcester, Mass. The Churchill organization also maintains offices in Montreal and Windsor. RICHARD A. WHITNEY is president of the firm and HOWARD WARD is vice-president and sales manager.

Obituary

JOHN C. PANGBORN, co-founder of Pangborn Corporation, Hagerstown, Md., died at his home in Hagerstown, Md., last Christmas Eve at the age of seventy-five. Along with his brother Thomas W. Pangborn, he founded the well-known blast cleaning and dust-control manufacturing concern in New York City in 1904. The company and its management moved to Hagerstown in 1912. In recent years he had served as vice-chairman of the board of directors and of the Pangborn Foundation. During his lifetime of philanthropy and service, Mr. Pangborn received many awards, and was a member of many community and fraternal organizations.

New Books

MANUAL OF LINGUISTS AND TRANSLATORS. By W. W. Bower. 451 pages; 5 1/2 by 8 1/2 inches; no illustrations. Published by the Scarecrow Press, 257 Fourth Ave., New York, N. Y. Price, $10.

Included in this volume are: Classification of Languages; a Directory of Linguists, Translators, Interpreters, and other foreign language specialists all over the world; International Translation Fees; Legal Information about Translations, Copyrights, Patents; Bibliography of Special Dictionaries, Encyclopedias, Manuals, Reference Works and Other Linguistic Aids; a Brief Guide for Translators; Useful Tables of Conversion Systems. A considerable amount of information relating to the translation of technical and scientific material is included.

METALLIZING HANDBOOK. 345 pages; 6 by 8 1/2 inches; illustrated. Published by Metallizing Engineering Co., Inc., 1101 Prospect Ave., Westbury, L. I., N. Y. Price, $5 postpaid.

This completely new metallizing handbook contains information including the very latest developments in the spraying, in powder form, of high melting point ceramics, such as alumina and zirconia, and hard-facing alloys including tungsten carbide. Profusely illustrated with pictures, diagrams, charts, and tabulated engineering data, it is an invaluable reference for anyone concerned with product design and materials engineering, as well as with machine maintenance, corrosion protection of iron and steel structures, and exposed equipment.

Coming Events

APRIL 21-28–ASTE Tool Show will be held at Detroit Artillery Armory, Detroit, Mich. For additional information write to Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

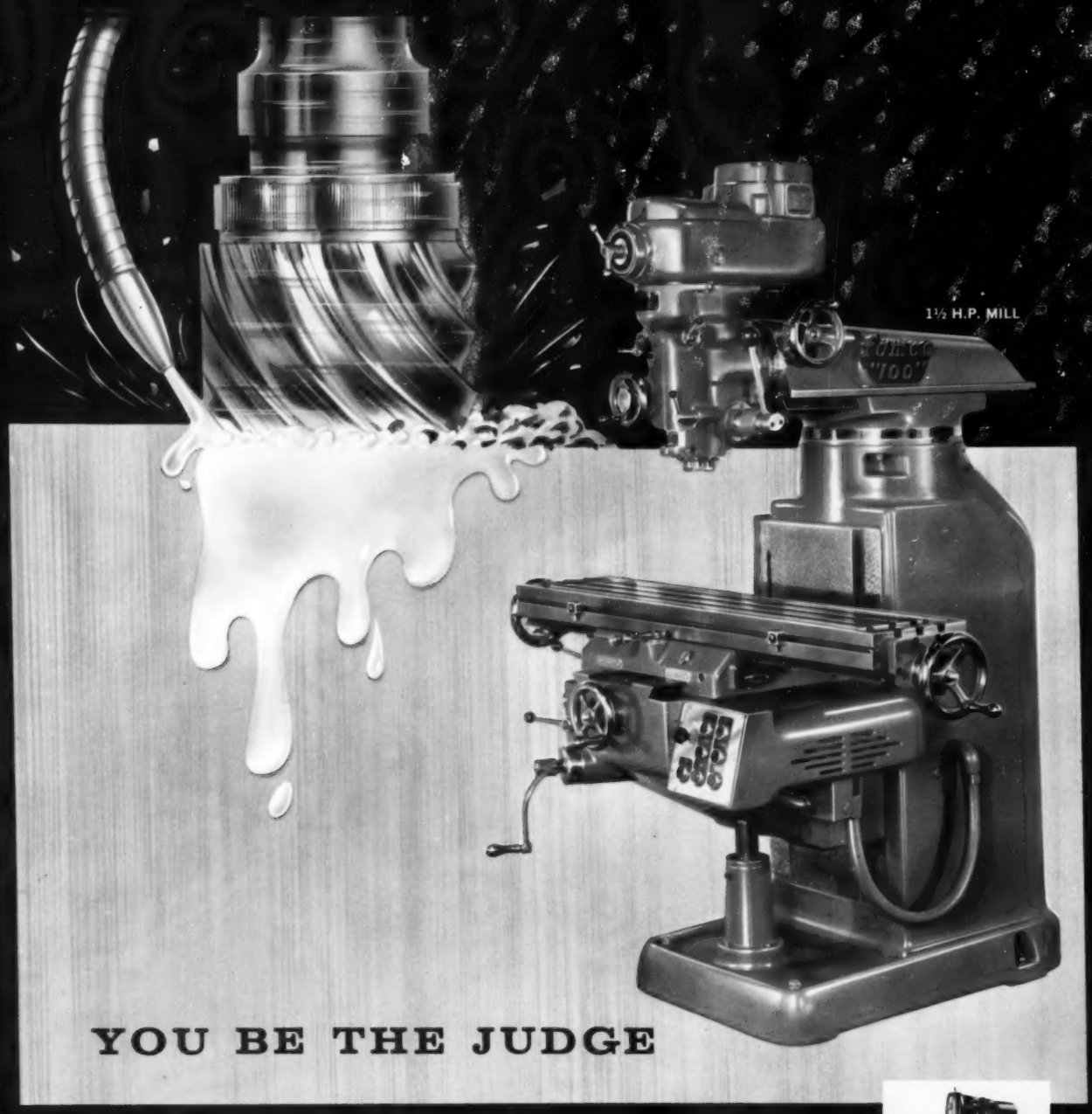
APRIL 25-26–ASME Maintenance and Plant Engineering Conference will be held at the Chase-Park Plaza Hotel, St. Louis, Mo. For additional information, write to L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

APRIL 25-29–ASME Metals Engineering Division–AWS Conference will be held at the Biltmore Hotel, Los Angeles, Calif. For further information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

MAY 9-13–Southwestern Metal Exposition will be held at State Fair Park, Dallas, Tex. For further information inquire of Chester L. Wells, exposition manager, the American Society for Metals, Metals Park, Novelty, Ohio.

MAY 17-19–ASME Production Engineering Conference will be held at the Schroeder Hotel, Milwaukee, Wis. For additional information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

MAY 23-26–ASME Design Engineering Conference and Show will be held at the Statler-Hilton Hotel, New York, N. Y. For further information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.



YOU BE THE JUDGE

Some of our customers are hardboiled characters who cut their teeth on blue chips and were weaned on cutting oil. No kidding, they are really down to earth. Yet they have told us that the Famco mill is the finest mill they have ever used.

Naturally, they have an easy time convincing us. We build them. But how can you be convinced?

We would like your opinion! Write for the brochure describing these machines or ask for the address of your nearest dealer. We'll be happy to oblige. In that way, you can judge Famco's milling machine superiority for yourself.

2 H.P. MILL

TRACER MILL

FAMCO MACHINE COMPANY KENOSHA 1, WISCONSIN

Manufacturers of:
Milling Machines, Presses • Air, Arbor, Power, Foot • Squaring Shears, Band Saws.

Yoder Rotary Slitters reduce inventory... speed production

To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths...completely engineered lines for special requirements.

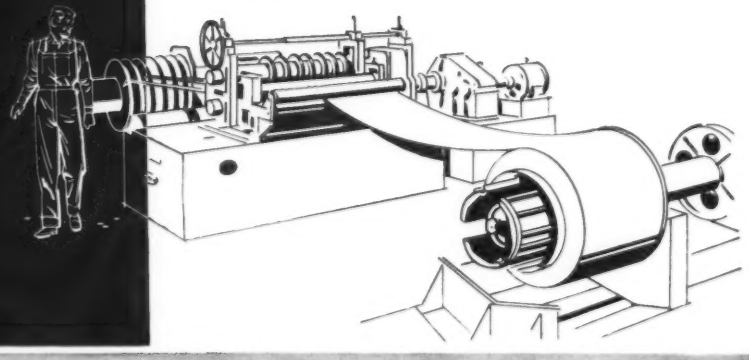
YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the YODER Slitter Manual.

THE YODER COMPANY

5504 Walworth Avenue • • Cleveland 1, Ohio

Investigate the many advantages of YODER-engineered Slitter Installations. Write today for this comprehensive, 80 page YODER Slitter Manual ...it's yours for the asking!



ENGINEERING **YODER** MANUFACTURING

ROTARY SLITTING LINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)

COLD ROLL FORMING MACHINES

ONE HOLE FREE IN EVERY THREE

Because the new SPEEDICUT "CHIPBREAKER" operates at 50% to 400% higher feed rates, it drills at least three holes in the same time ordinarily required for only two with even the finest general purpose or heavy duty drill. And more holes per regrind means less down time and further savings in production costs.

See a demonstration in your own plant on your own equipment and type of work. Your local authorized SPEEDICUT "CHIPBREAKER" distributor will gladly arrange it. Write for literature and name of distributor.

THE PATENTED RIB
that cannot be duplicated

SPECIFY
SPEEDICUT "CHIPBREAKER"
SPEED WITH SAFETY

SPEEDICUT DIVISION. CHICAGO HEIGHTS STEEL CO. • CHICAGO HEIGHTS, ILL.

Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

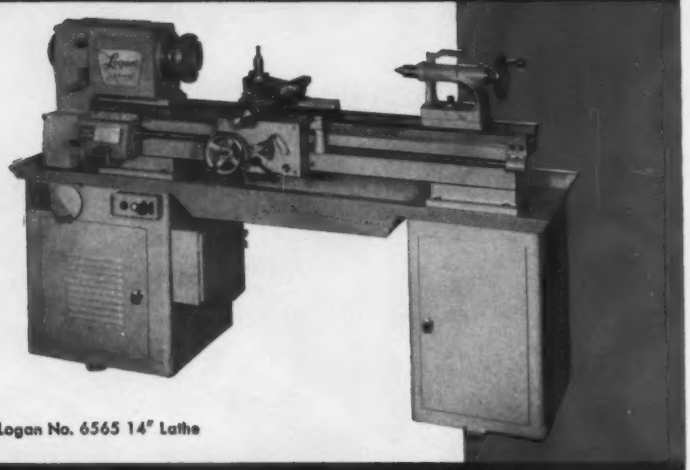
ABRASIVES, Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester, Mass.

ABRASIVES, Polishing, Tumbling, Etc.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

ACCUMULATORS, Hydraulic
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

its specifications add up to high production capacity

Logan 14" Lathe



Logan No. 6565 14" Lathe

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-capacity features. For instance—

- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

There are many more reasons why this and other Logan Lathes have a greater capacity. The complete specifications tell the story. Write for them.

- Spindle speeds to 2000 rpm
- 1½" Levermatic collet chuck capacity
- 14⅝" swing over bed
- 9" swing over saddle cross slide
- 40" between centers

LOGAN ENGINEERING CO. Dept. K-260 4901 Lawrence Avenue, Chicago 30, Illinois

AIR GAGES, Dimensional—See Gages Air Comparator

AIR GUNS
Chicago Pneumatic Tool Co., New York, 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Tool Steel Co., Chicago Hts., Ill.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Jessop Steel Co., Washington, Penna.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Mueller Brass Co., Port Huron, Mich.

ALUMINUM and Aluminum Products
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

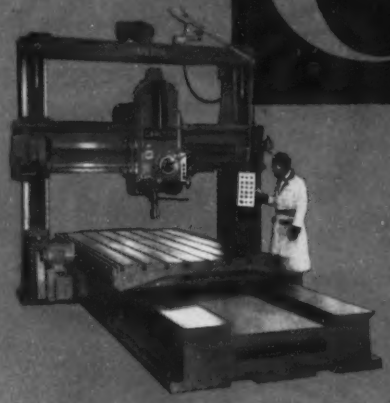
ANGLE PLATES—See Set-up Equipment

ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.
General Electric Co., Schenectady 5, N. Y.

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS
Birdsboro Corp., Birdsboro, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill. (end mills)
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mich. Co., Inc., Logansport, Ind.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

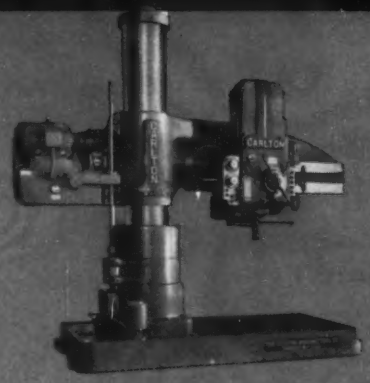
Carlton



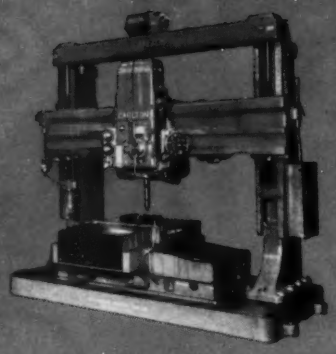
NEW PLANER TYPE BORING AND DRILLING MACHINE with automatic positioning. Accurately locates work for boring, reaming, drilling, tapping. Bulletin ARS.

HORIZONTAL DRILLS provide production boring and drilling facilities for huge, irregular shaped parts that can't be handled under standard machines. Bulletin C 217.

for all your heavy duty boring and drilling requirements



RADIAL DRILLS. The best known, most highly respected and widely used radial drills. Made in column diameters from 9" to 26", arm lengths from 3-ft. to 12-ft. Write for bulletins.



NEW VERTICAL DRILLING MACHINE with automatic positioning (or spacing) table. Introduces jigless heavy duty boring and drilling, puts it on a production basis for the first time. Bulletin C 216.

NOW: NUMERICAL CONTROL by Carlton Controls Corp. for Carlton 4H and 5H horizontal drills and for Model ARS planer type boring and drilling machine. Write for complete information.

THE CARLTON MACHINE TOOL CO., CINCINNATI 25, OHIO / *Specialists in boring and drilling machines since 1916*

For more data circle this page number on card at back of book

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"In my job shop in Denver I have twelve LeBlond Lathes, six of them purchased in the last year. LeBlond Lathes are the best dollar investment I can make."

Tom Ragsdale

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THOMAS A. RAGSDALE

Vice President, Ragsdale Bros. Tool & Die, Inc., Englewood, Colo.

LeBLOND of Cincinnati

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TESTIMONIAL

LeBLOND of Cincinnati

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With LeBlond Lathes"

"Tom Ragsdale tells me that his LeBlond Lathes give him a definite advantage over his competition. It's things like this that make me proud I sell LeBlonds."

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R. E. DUBOC

President, R. E. Duboc Associates, Denver, Colo.

MACHINE TOOL COMPANY

LeBLOND of Cincinnati

The R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio

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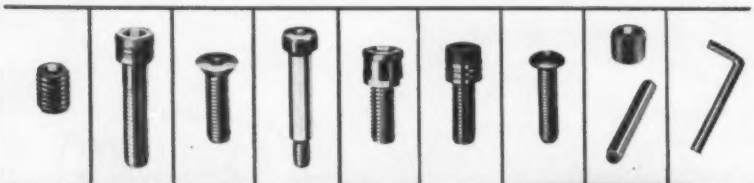
*"Specialists On Sockets..."

are all Blue Devil distributors

When you have a problem involving socket screws or their application, it will pay you to call in your nearby Blue Devil distributor. His well qualified experience is always at your service, and he carries complete stocks for immediate delivery in any quantity.



Actual cross-section diagram shows how cold forming of Blue Devil Socket head insures unimpaired fiber continuity.

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Sheffield Corp., Box 893, Dayton 1, Ohio

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BACTERICIDES

Oakite Products, Inc., 26 Rector St., New York 6, N. Y.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sunstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS

Hoover Ball & Bearing Co., Ann Arbor, Mich.
Kennametal, Inc. Latrobe, Penna.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

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Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Shenango Furnace Co., Dover, Ohio

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Fafnir Bearing Co., New Britain, Conn.
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Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
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Other manufacturers have found that Cushman Air Chucks and Cylinders have effected outstanding production savings on both new and old equipment. Send for Bulletin No. PO-66D describing the many benefits and see for yourself.

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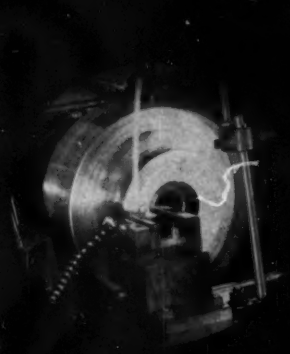
Hartford 2, Connecticut



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4CS60

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Rounded corners for finger comfort
Rounded head distributes impact, reduces mushrooming.
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Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
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Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
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Rollway Bearing Co., Inc., Syracuse, N. Y.
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BELT SANDERS—See Grinding Machines, Abrasive Belt

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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING ROLLS
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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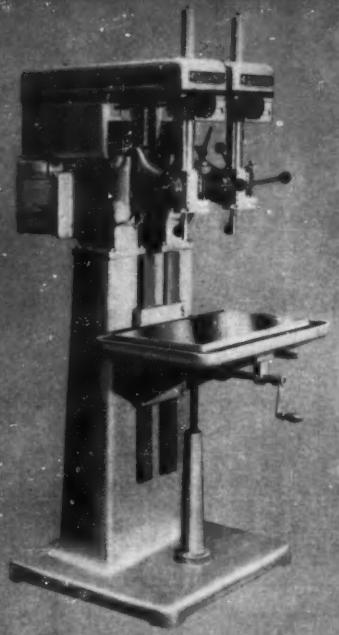

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Sensitive machine for small parts and components.

Infinite selection of speeds to 10,000 rpm

7" & 10" Overhang

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Pedestal and Bench models

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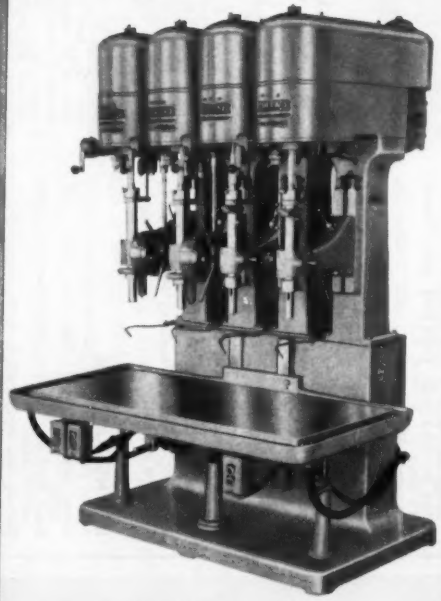

Edlund Model 2F

A top production machine for medium to heavy drilling and tapping.

Infinite selection of speeds to 3,600 rpm
8"–12"–15" Overhang 1¼" Capacity

Pedestal and Round Column types

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A work-horse production machine for heavy duty drilling and tapping operations.

1¾" capacity with infinite selection of speeds to 2200 rpm

12" Overhang

Pedestal or Round Column Types

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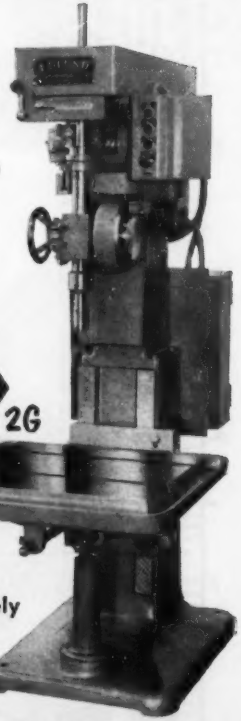

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Cortland, New York

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Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Metallurgical Products Dept. of General Electric Co., Box 327, Roosevelt Park Annex, Detroit 32, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
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Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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Austin Industrial Corp., White Plains, N. Y.
Baker Bros. Inc., 1000 Post Ave., Toledo 10, Ohio
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Bullard Co., Bridgeport 6, Conn.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., P.O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Ex-Cell-O Corp, 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Jones & Lamson Machine Co., Springfield, Vt.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893 Dayton 1, Ohio
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Wales-Strippit, Inc., Akron, N. Y.

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Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio
Innocenti, Milan, Italy
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

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Bethiez, Charles, 5 Rue Montalivet, Paris, France
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

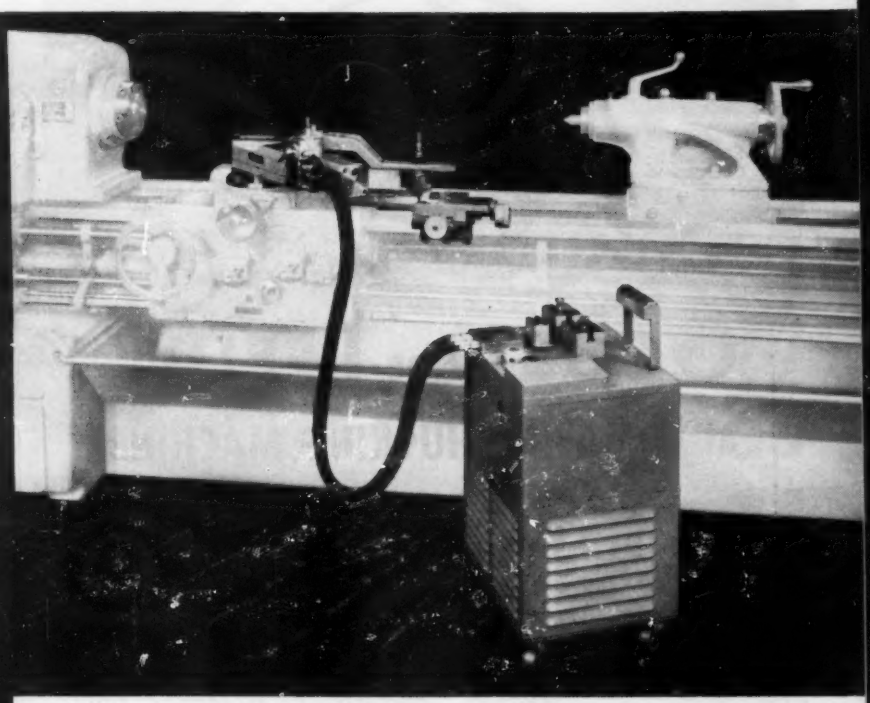
BORING TOOLS
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Maxwell Industries, Inc., Ashtabula, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegon, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BRAKES, Press and Bending
Cincinnati Shaper Co., P.O. Box 111, Cincinnati 11, Ohio
Cleveland Crane & Engrg. Co., Wickliffe, Ohio
Lodge & Shipley Co., Hamilton 1, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 93rd St. and S. Kenwood Ave., Chicago, Ill.

BRASS
American Brass Co., 25 Broadway, New York N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.

Monarch's Building Higher Production for Tomorrow's Boom

THE LATHE ON YOUR FLOOR WILL PRODUCE MUCH MORE



3..The New Air-Tracer Pak... Portable Unit for Standard Monarchs in Your Plant

Here's a real turning technique breakthrough! The Air-Tracer Pak is just what the name implies—a portable, easily applied device for temporarily or permanently adding to many standard Monarchs in your shop *all the advantages of Air-Gage Tracer production.*

And what are those advantages? In a nutshell, this, the most accurate duplicating method in general use, always outproduces manual operation up to 8 to 10 times. It sizes automatically and, using only a single running tool, is ideal for *small lot repetitive work* without the need for expensive form tools or multiple tool setups.

Its accuracy of ± .001" on most work often cuts in half the stock left for grinding; sometimes eliminates grinding and polishing. It allows complete setup change in as little as 15 to 20 minutes and tool change in 1 minute. It is also the simplest, most trouble-free of all lathe duplicating units.

The photos show how the tracer slide assembly quickly replaces the regular compound rest on the cross slide. Note the template support and micrometer dials—the portable, completely self-contained power unit at the front of machine with air supply and electrical connections in the base.

Presto! it's on. And presto! it's off. Yet it's an adaptation of the time-tested swiveling Air-Gage Tracer with the versatility to handle the more complex turning, boring and facing jobs.

This is news! Write—or phone today—for the full story... The Monarch Machine Tool Company, Sidney, Ohio.

Monarch
TURNING MACHINES

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

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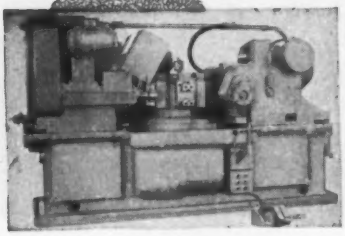
GOSS and DE LEEUW
AUTOMATIC CHUCKING MACHINE



means a complete piece... at each index cycle

When a piece is finished it is *completely* finished without the necessity of a second operation. Furthermore it means *more* finished pieces in a given period of time and greater accuracy in every finished piece.

The "1-2-3" Method is exclusive with Goss & DeLeeuw. With it, three ends of a piece can be machined at a single chucking of the work, simultaneously or in sequence depending on the operations involved. It will pay you to investigate.

Send for illustrated literature giving detailed information. Send samples and ask us to give you cost estimates of handling this work on a "1-2-3" Goss & DeLeeuw Automatic Chucking Machine

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Lapointe Machine Tool Co., Hudson, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

BROACHING MACHINES, Internal
Lapointe Machine Tool Co., Hudson, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pioneer Broach Co., 6434 Telegraph Rd., Los Angeles 22, Cal.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Lapointe Machine Tool Co., Hudson, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pioneer Broach Co., 6434 Telegraph Rd., Los Angeles 22, Cal.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE
American Brass Co., Waterbury 20, Conn.
Mueller Brass Co., Port Huron 35, Mich.

BRUSHES, Industrial, Tampico, Wire Wheel, Etc.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

BUFFERS
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

BULLDOZERS, Metalforming
Birdsboro Corp., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Lamb, F. Joseph Co., 5863 E. Nine Mile Rd., Detroit 34, Mich.

BURRING MACHINES—See Deburring Machines

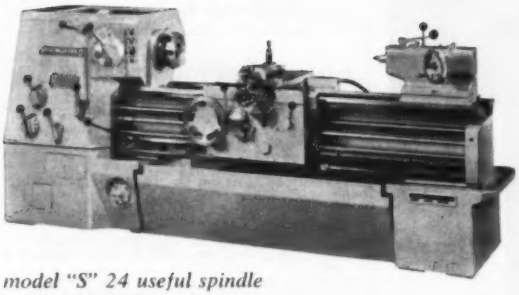
BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Universal Engrg. Co., Frankenmuth, Mich.

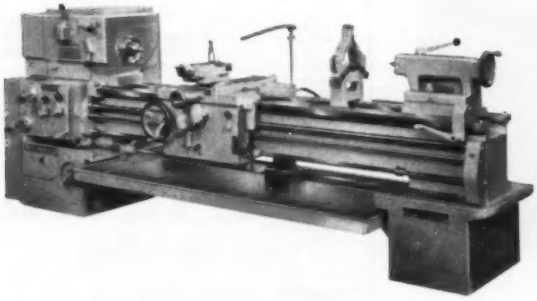
CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools Machinists' Small Tools



model "S" 24 useful spindle speeds, 66 feeds & threads heavy duty 16" medium duty 20"

MMT=PE

new developments coming!



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Springfield lathes have 10, 15 or 20 horsepower motors for heavy cuts, and have simple, practical features that keep the operator productive and keep the maintenance man away. Pressurized mist lubricates the headstock. Only four gears are in mesh for a given speed—the others run free. Clean, functional design and simplified controls promote pride of workmanship and minimum waste motion.

Ruggedness with precision has always been characteristic of Springfield lathes—because they are built to *one* standard of excellence. A Springfield engine lathe meets the accuracy standards set up for toolroom lathes —without *any* cost penalty.

Whenever you want maximum power and efficiency, and the cost designed out by designing simplicity in, consider a Springfield lathe. A full range of attachments is available—hydraulic contouring and reproducing, plain and universal relieving, taper, etc.

If you would like to know more about Springfield lathes, please write for Bulletins 190-G and 201-G.

The Springfield Machine Tool Company
Springfield, Ohio

SPRINGFIELD

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Equitable Engineering, Royal Oak, Mich.
Rowbottom Machine Co., Waterbury, Conn.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65 St., Cleveland 2, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 781 Union Commerce Bldg., Cleveland 14, Ohio
Meehanite Metal Corp., New Rochelle, N. Y.
Shenango Furnace Co., Dover, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Textile Machine Works, Reading, Penna.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Corp., Birdsboro, Pa.
Jessop Steel Co., Washington, Penna.

CEMENT, Abrasive Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
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(Continued on page 236)

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- One type of tool features total stroke of 2", of which 1" may be fully hydraulically controlled, preventing break-through damage to material and to sensitive cutting tools . . . also incorporates adjustable rapid approach for minimum cycling time.
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- Buckeye engineers will work with you in applying these tools to fit your requirements for drilling, tapping, fastening, grinding, reaming, counterboring and wire brushing.

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Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor

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Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P.O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

CHUCKING MACHINES, Single-Spindle Automatic

Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio

CHUCKS, Air Operated

Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8 Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

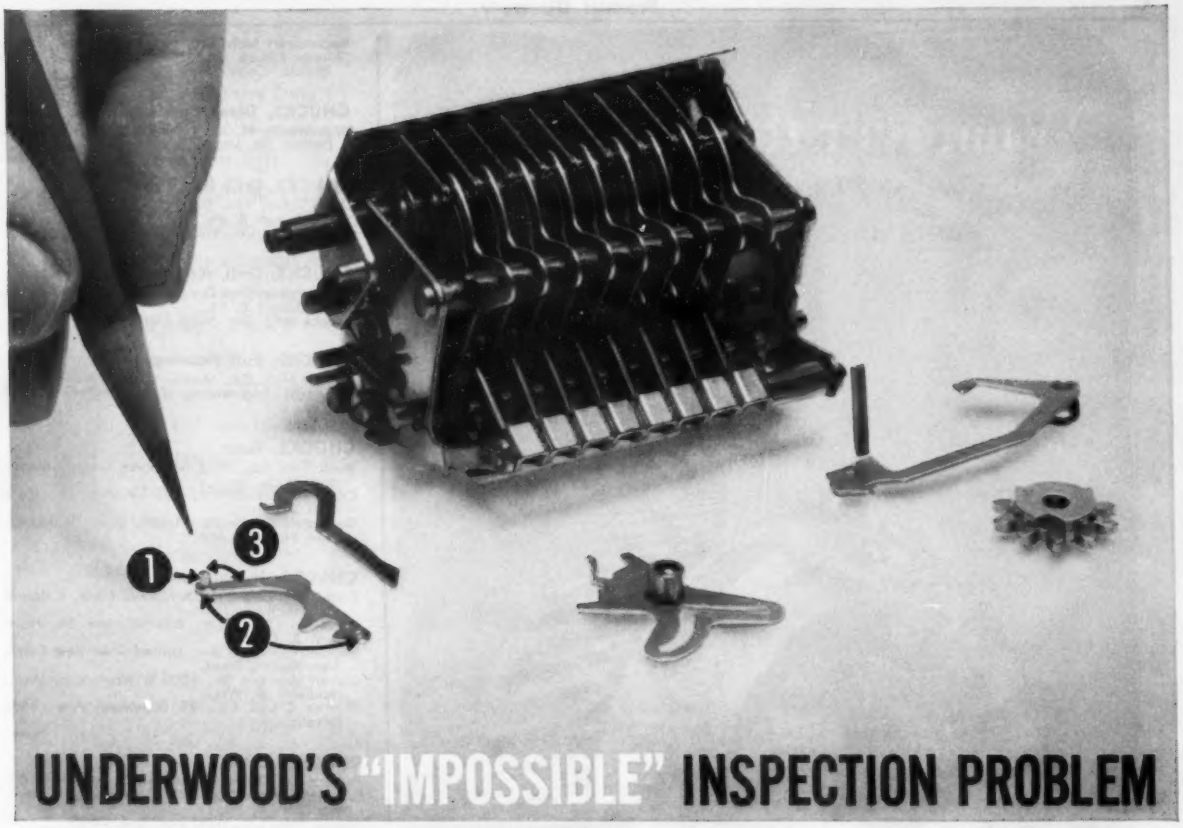
CHUCKS, Combination Universal-Independent

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.

(Continued on page 238)



UNDERWOOD'S "IMPOSSIBLE" INSPECTION PROBLEM AND HOW IT WAS SOLVED

THESE INTRICATE PARTS go into the complex assembly at the top of the picture. This assembly masterminds Underwood Corporation's popular adding machine, *Add-Mate*.®

Precision is critical. Each odd-shaped part —whether machined, stamped, or formed— is different; yet *all* must meet close tolerances. One part, the carryover pawl arm (numbered), defied complete inspection by ordinary mechanical methods.

The stud diameter (1) and spread between stud and slot (2) of the pawl arm could be inspected using a go and no-go gage, at rates of 450 and 400 per hour respectively. For dimension (3)—stud angularity to 90° ± 1°—mechanical inspection was impractical.

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Underwood relies on the Kodak Contour Projector, both in production and inspection, to assure adding machine accuracy. Stringent sample checks of parts help control production machine efficiency. And all finished parts receive 100% inspection.

If you have similar "impossible" inspection problems . . . if inspection for you seems to be taking too much time . . . or if accuracy isn't what you think it should be, an Optical Gaging Products* man can help you.

And when optical gaging will solve it, remember you get *more* with a Kodak Contour Projector.

You get ample, uniform working space—a constant 8″ of clearance for parts and fixtures regardless of magnification.

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You get highly accurate images even at the critical outer edges of the screen.

You get upright images of all inspected parts for easier reference.

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***Kodak Contour Projectors are distributed nationally by Optical Gaging Products, Inc.,** 26 Forbes Street, Rochester 11, N. Y.

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the KODAK CONTOUR PROJECTOR

Kodak
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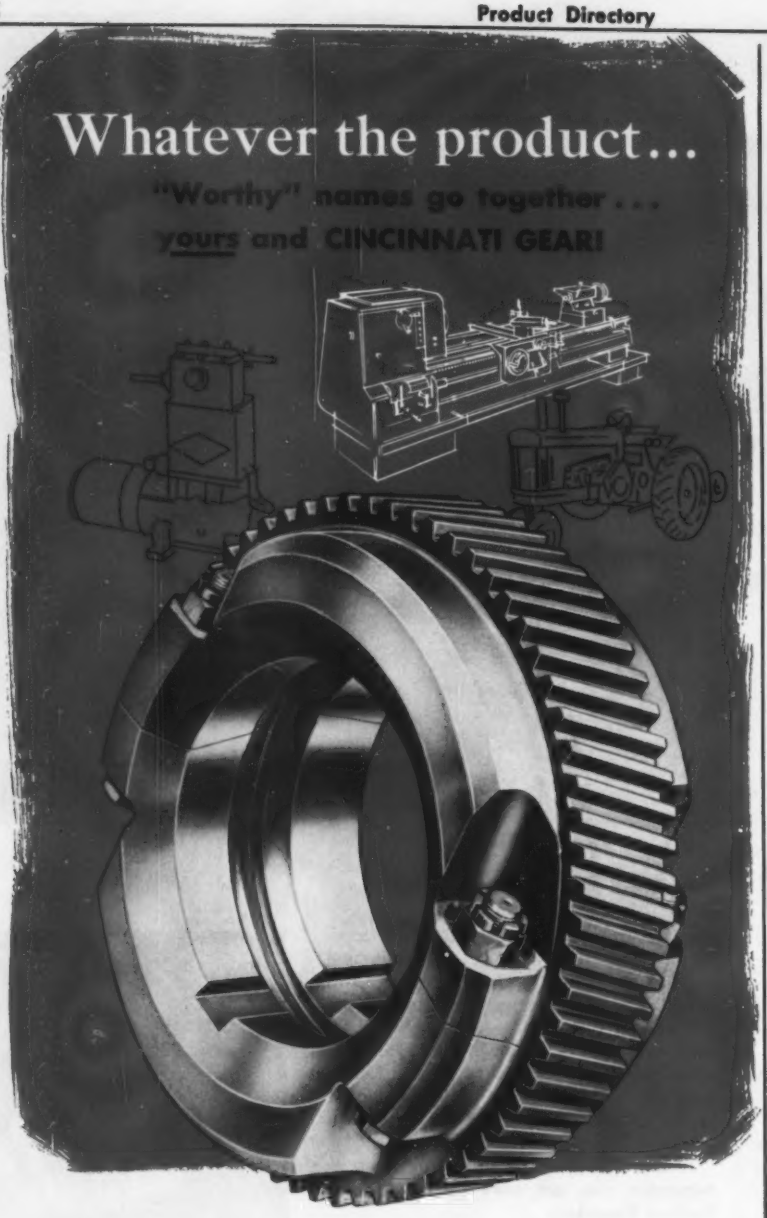

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Jacobs Mfg. Co., West Harford, Conn.

CHUCKS, Drill, Keyless
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Full Floating
Gisholt Mch. Co., Madison 10, Wis.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.

CHUCKS, Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathe
Bullard Co., Brewster St., Bridgeport 2, Conn.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
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CHUCKS, Magnetic
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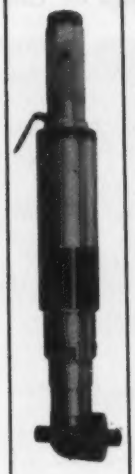
CHUCKS, Power Operated
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.

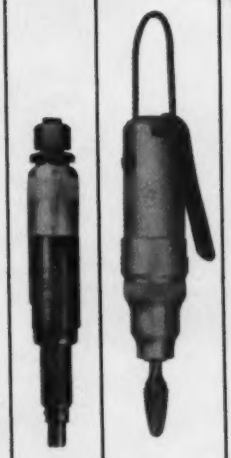
CHUCKS, Ring Wheel
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Topping
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Universal Three-Jaw
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.



Cleco air tools range in type and size from a small precision die grinder (length: 4⅞ ins. — weight: 12 ozs.) to custom-designed multiple spindle assembly units. This complete line includes Cleco's amazingly unique Clecomatic* screwdriver — nut-runners and nutsetters. The completely automatic air tools with positive torque control!



Cleco air tools are as quiet, as light weight, as economical, and as maintenance free as a tool can be and still do the job it was designed to with more efficiency than its rated capacity calls for. This is a true characteristic of Cleco Tools . . . their job performance usually exceeds your most critical demands.

To see how well a Cleco production-proved tool can do your job, call your Cleco® representative for a demonstration-tryout.

CLECO
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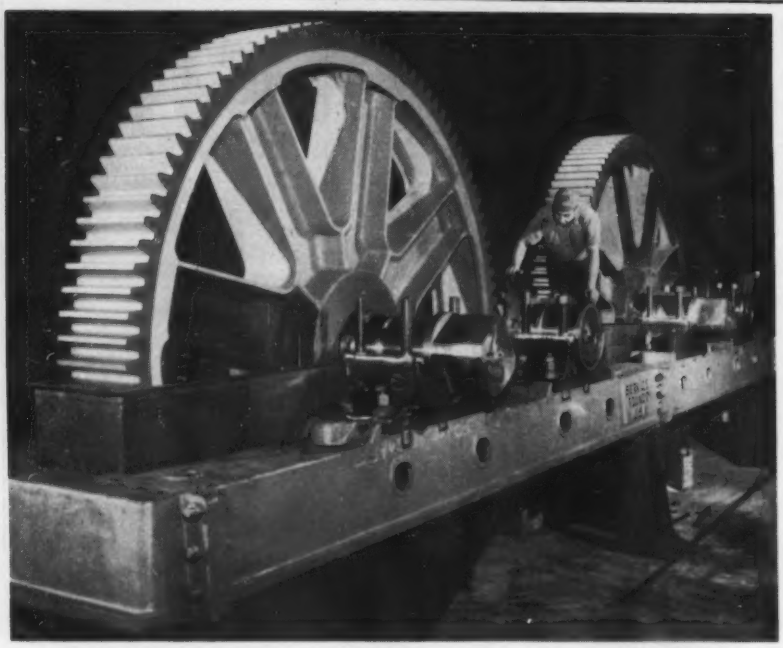

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CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

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Rowe Machinery & Mfg. Co., Inc., Dallas, Texas

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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

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COMPOUNDS, Cuttings, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air
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CONTOUR FOLLOWER—See Tracing Attachments

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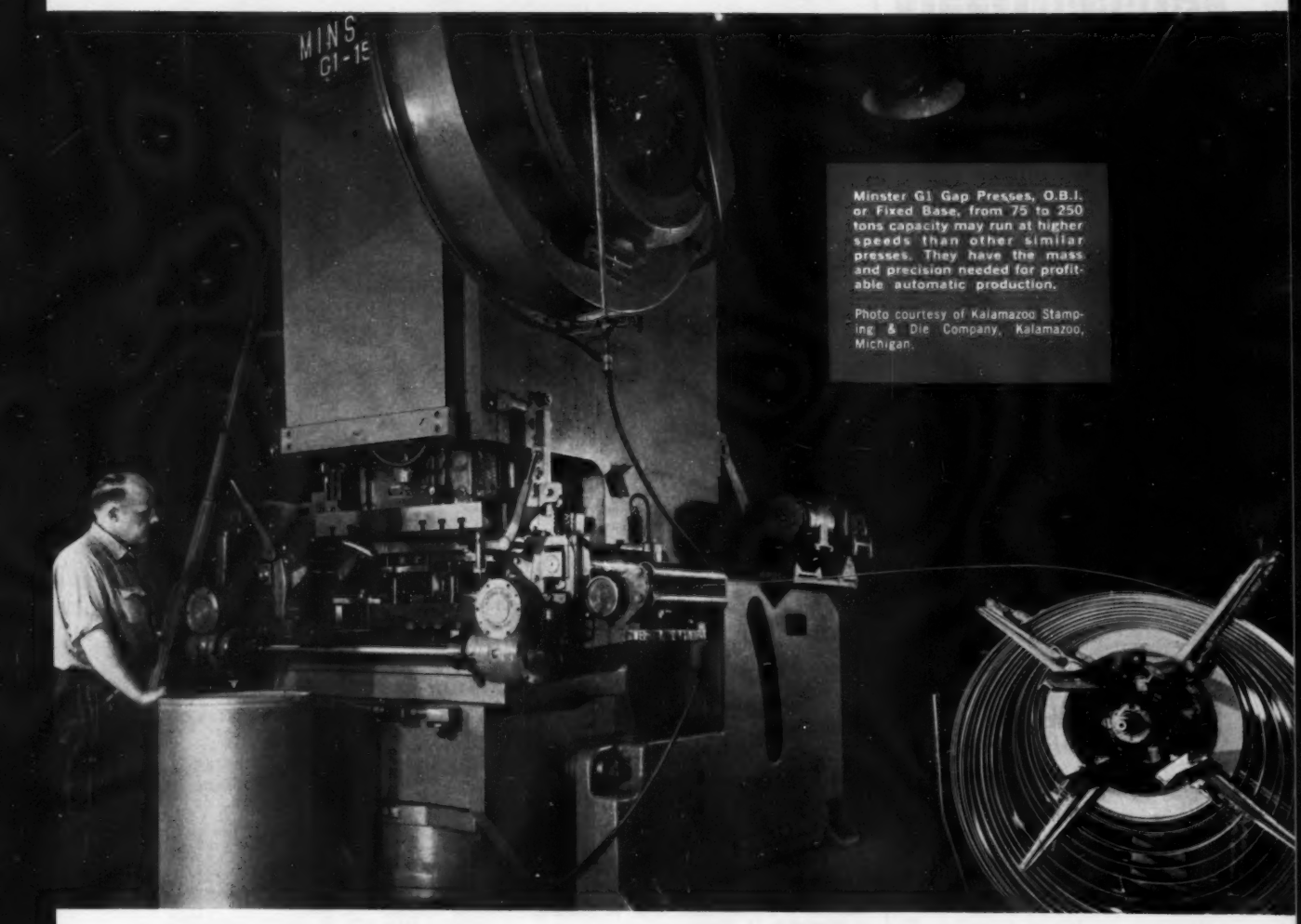

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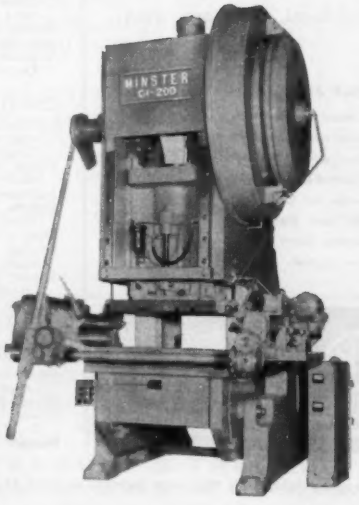

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DoALL Co., Des Plaines, Ill.
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DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Tomkins-Johnson Co., Jackson, Mich.
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Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
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Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

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Chicago Pneumatic Tool C., New York 17, N. Y.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
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Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

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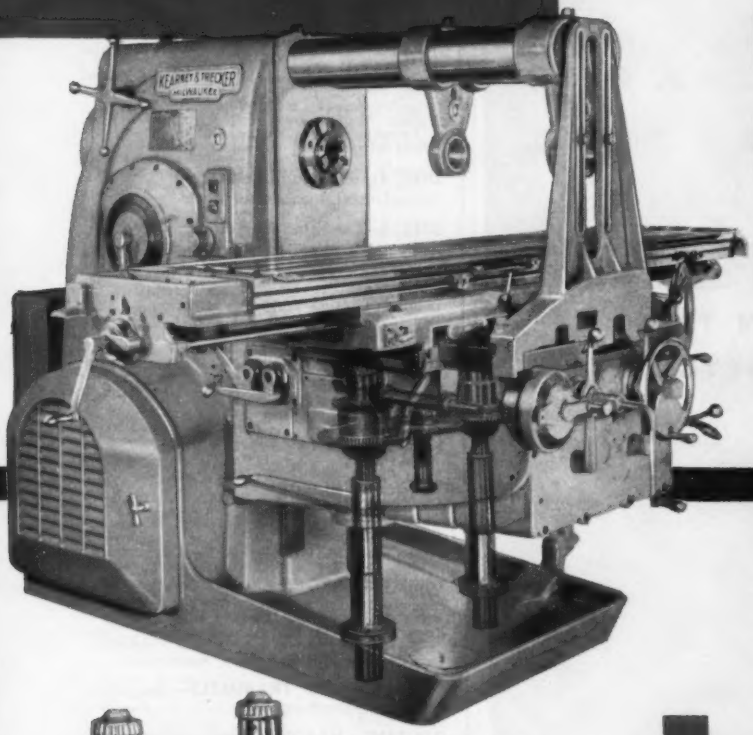

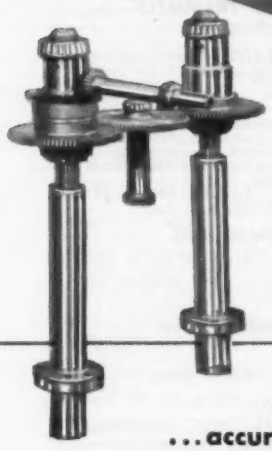

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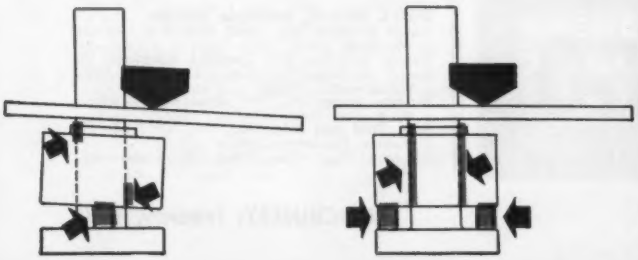

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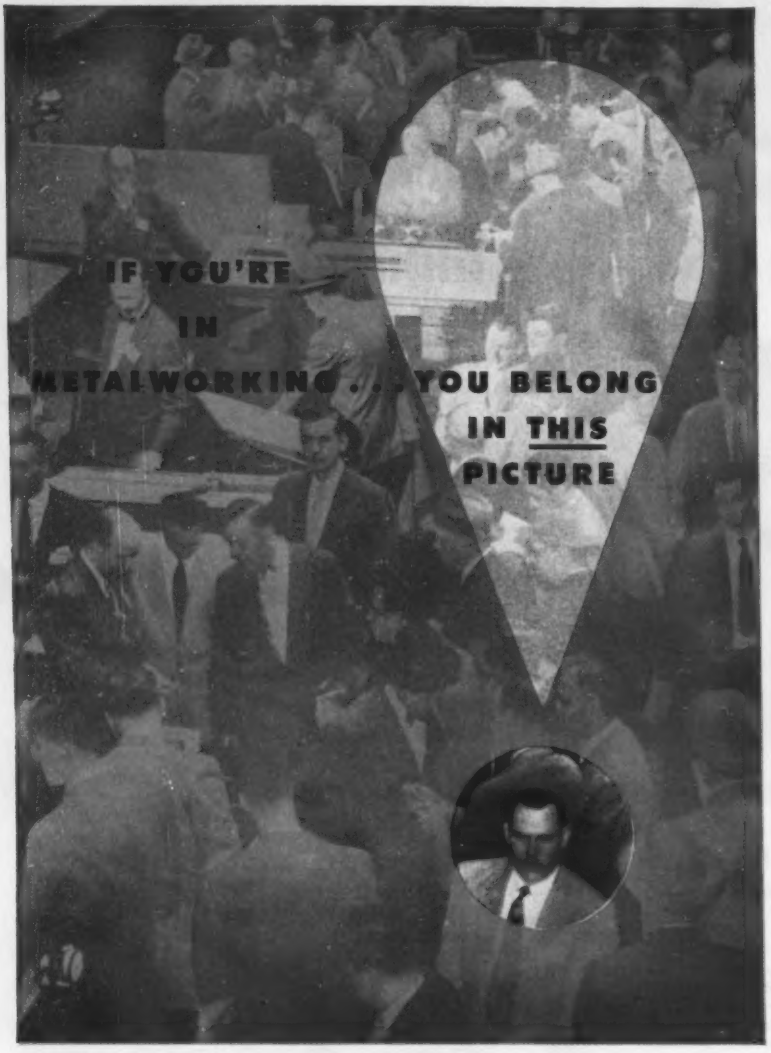

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Jones & Lamson Mch. Co., Springfield, Vt.
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National Acme Co., 170 E. 131st St., Cleveland, Ohio.

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DIES, Thread Rolling
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DIVIDING HEADS—See Indexing and Spacing Equipment

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Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

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DoALL Co., Des Plaines, Ill.

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Clausing Div., Atlas Press Co., Kalamazoo, Mich.

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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Root, B. M., Co., York, Pa.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
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Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILLING MACHINES, Bench

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Hamilton Tool Co., 834 9th St., Hamilton, Ohio.
Leland-Gifford Co., Box 989, Worcester, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.

DRILLING MACHINES, Deep Hole

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Berthiez, Charles, 5 Rue Montalivet, Paris, France.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Wales-Strippit, Inc., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester, Mass.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Root, E. M., Co., York, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILLING MACHINES, Radial

American Tool Works Co., Pearl & Eggleston Ave., Cincinnati, Ohio.
Burg Tool and Mfg. Co., Inc., 15001 Figueroa, Gardena, Calif.
Carlton Mch. & Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.

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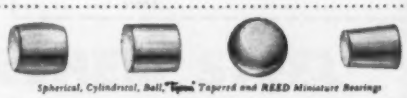

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Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Eldorado Tool & Mfg. Corp., Milford, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DRILLS, Oil Hole, Oil Tube
Chicago Heights Steel Co., Chicago Hts., Ill.
Chicago-Latrobe, 411 Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Portable pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Ratchet
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DRILLS, Subland
Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.

DRILLS, Twist, High-Speed Steel, Carbon Steel
Ace Drill Corp., Adrian, Mich.
Chicago Heights Steel Co., Chicago Hts., Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio
Cogsdill Twist Drill Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

ELECTRICAL DISCHARGE MACHINES
—See Disintegrators

ELECTRONIC CONTROL SYSTEMS
Hughes Products, International Airport Station, Los Angeles 45, Cal.
Micro-Path Inc., Ingelwood 2, Calif.
Reliance Electric & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Stromberg-Carlson Div., General Dynamics Corp., 1493 N. Goodman St., Rochester 3, N. Y.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

EXTRACTORS, Screw
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

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Allen Mfg. Co., Bloomfield, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
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New. Headstock and Apron running in oil.
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New. 60-pitch Gear Box with built-in Lead Screw Reverse.
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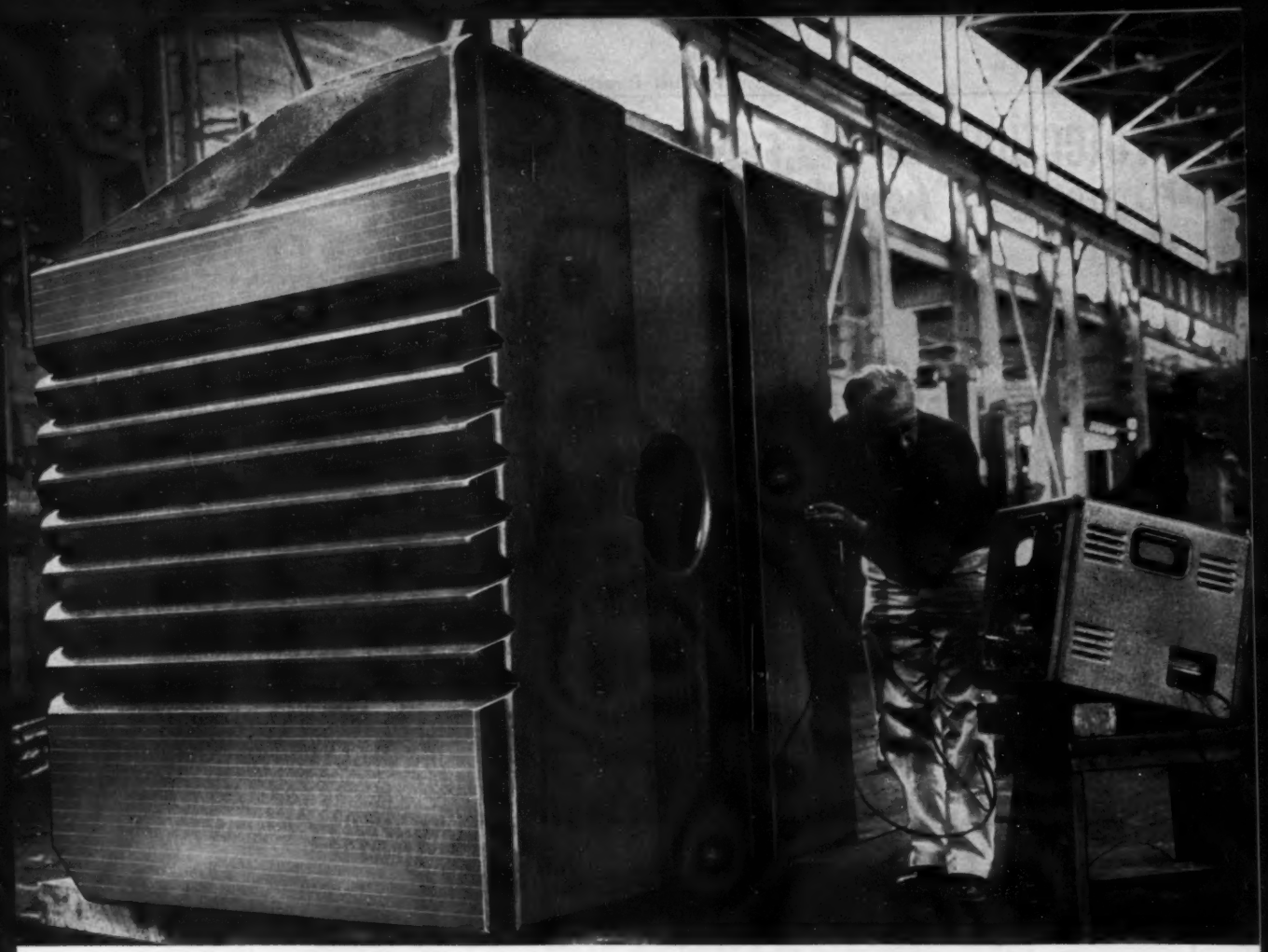

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It weighs in at 50,000 pounds. And it measures 54¼ inches from top to bottom—59⅛ inches from side to side—66 inches from front to back. Here at Bethlehem, we've never heard of a larger *forged* hammer ram. Have you? If so, we'd certainly like to know the details. Would you be good enough to drop a line or two to Forgings Sales? (And end our suspense over whether we've chalked up another record, or an also-ran?)

A few other facts about this hammer ram: we forged it from nickel-chrome-molybdenum-vanadium steel; we heat-treated and tested it to our customer's specifications; and, as you can see, we furnished it finish-machined, ready to start pounding in a steam drop hammer.

Although this ram is surely a giant in its class, it's a pygmy compared to some of the forgings we've made. Our shops turn out the largest forgings ever needed—some weighing over 200 tons. (Some of the smallest, too—drop forgings, for example, that weigh as little as one pound.)

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The Modern Way

Automatic operation—from loading to final cut-off. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts any material that can be turned. 16 spindle speeds.

107

The Modern Automatic Cutting-Off Machine and Bar Feeder Combination, shown above, handles random lengths of tubing, pipe and bar stock. With this combination the entire load is fed to the cutting-off machine without attention of an operator. Feeders are available for any maximum length bars. Only one single crank adjustment needed—for stock diameter.

WRITE FOR CATALOG

Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

MODERN MACHINE TOOL CO.
2005 LOSEY AVENUE
Jackson, Michigan

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FEEDERS, Automatic
Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Gear-O-Mation Div., Michigan Tool Co., 7171 McNichols Rd., Detroit 12, Mich.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

FILES, Band
DoALL Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoALL Co., Des Plaines, Ill.

FILES AND BURRS, Rotary
DoALL Co., Des Plaines, Ill.
Jarvis Corp., Middletown, Conn.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Cuno Engineering Corp., Meriden, Conn.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.
U. S. Hoffman Machinery Corp., Syracuse, N.Y.

FLAME-HARDENING MACHINES
Cincinnati Milling Machine Co., Meta-Dynamics Div., Marburg Ave., Cincinnati 9, Ohio
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FLEXIBLE SHAFT EQUIPMENT
Jarvis Corp., Middletown, Conn.

FORGING HAMMERS, Steam and Air
Chambersburg Engrg. Co., Chambersburg, Pa
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Mueller Brass Co., Port Huron 35, Mich.

FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Upset
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.

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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., Mount Gilead, Ohio
Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
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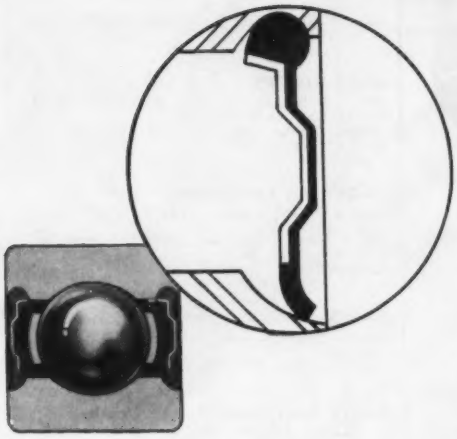

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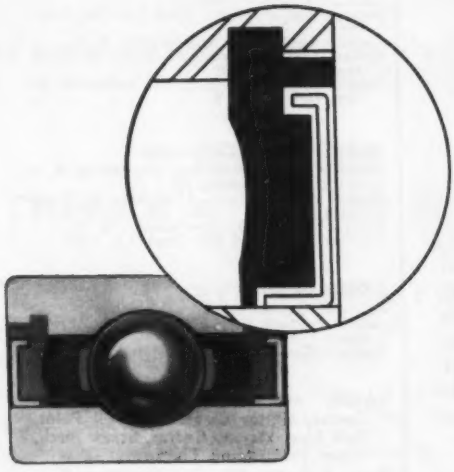

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- best seal available for cartridge width bearings

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MARLIN-ROCKWELL CORPORATION
JAMESTOWN, NEW YORK

MRC
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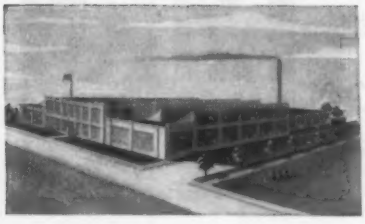

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Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
U. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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DoALL Co., Des Plaines, Ill.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Automatic Sorting
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.
Ames, B. C. Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., P. O. Box 3806, Detroit, Mich.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
General Electric Co., Schenectady, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

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DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
General Electric Co., Schenectady, N. Y.
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GAGES, Grinding
Equitable Engineering, Royal Oak, Mich.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
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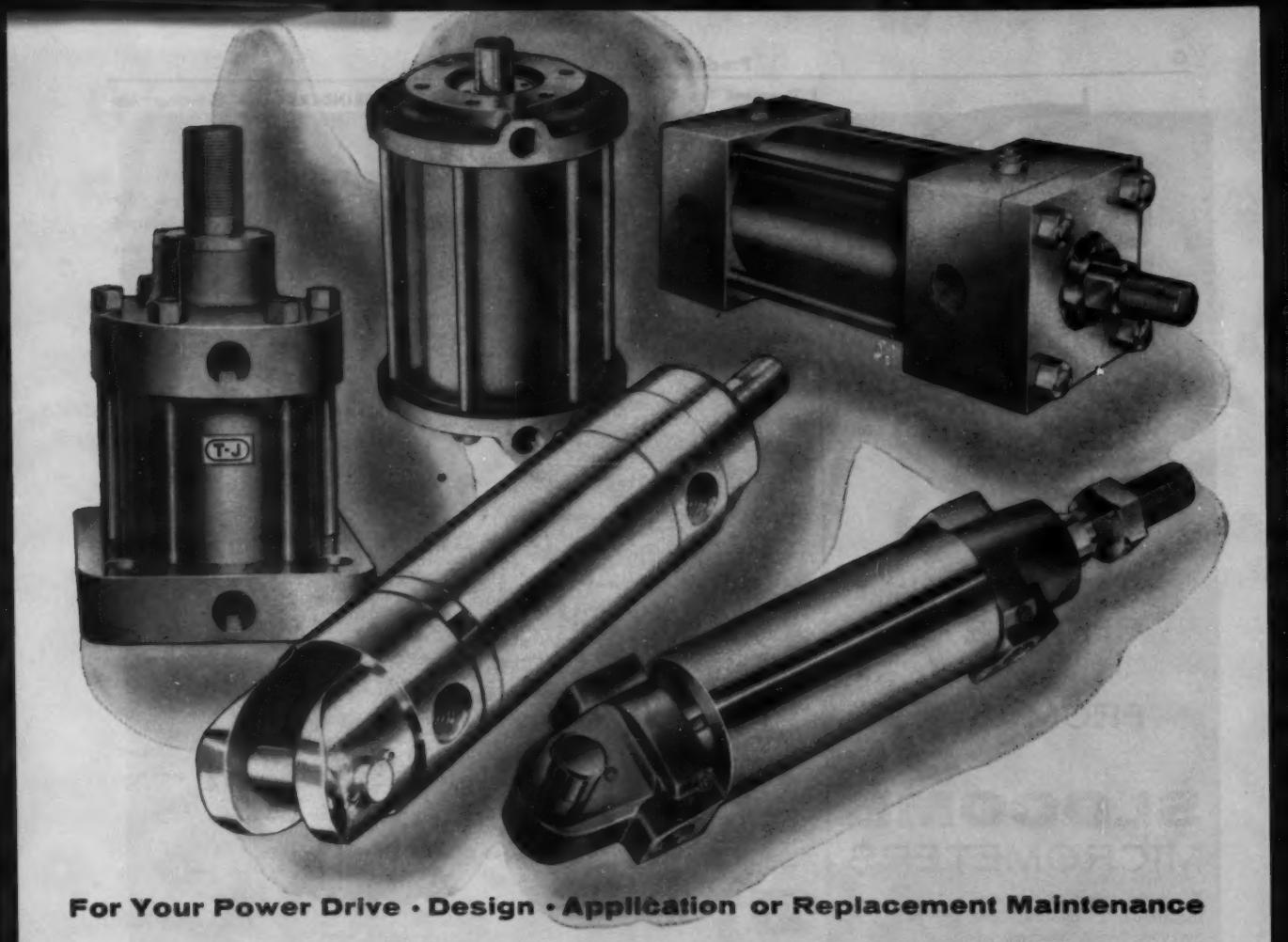
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

GAGES, Multiple Inspection
Federal Products Corp., 1144 Eddy St., Providence 1, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Plug and Ring
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

(Continued on page 254)



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Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Equitable Engineering, Royal Oak, Mich.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Illinois Gear & Mch. Co., 2108 N. Natchez Ave., Chicago 5, Ill.
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Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
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Equitable Engineering, Royal Oak, Mich.
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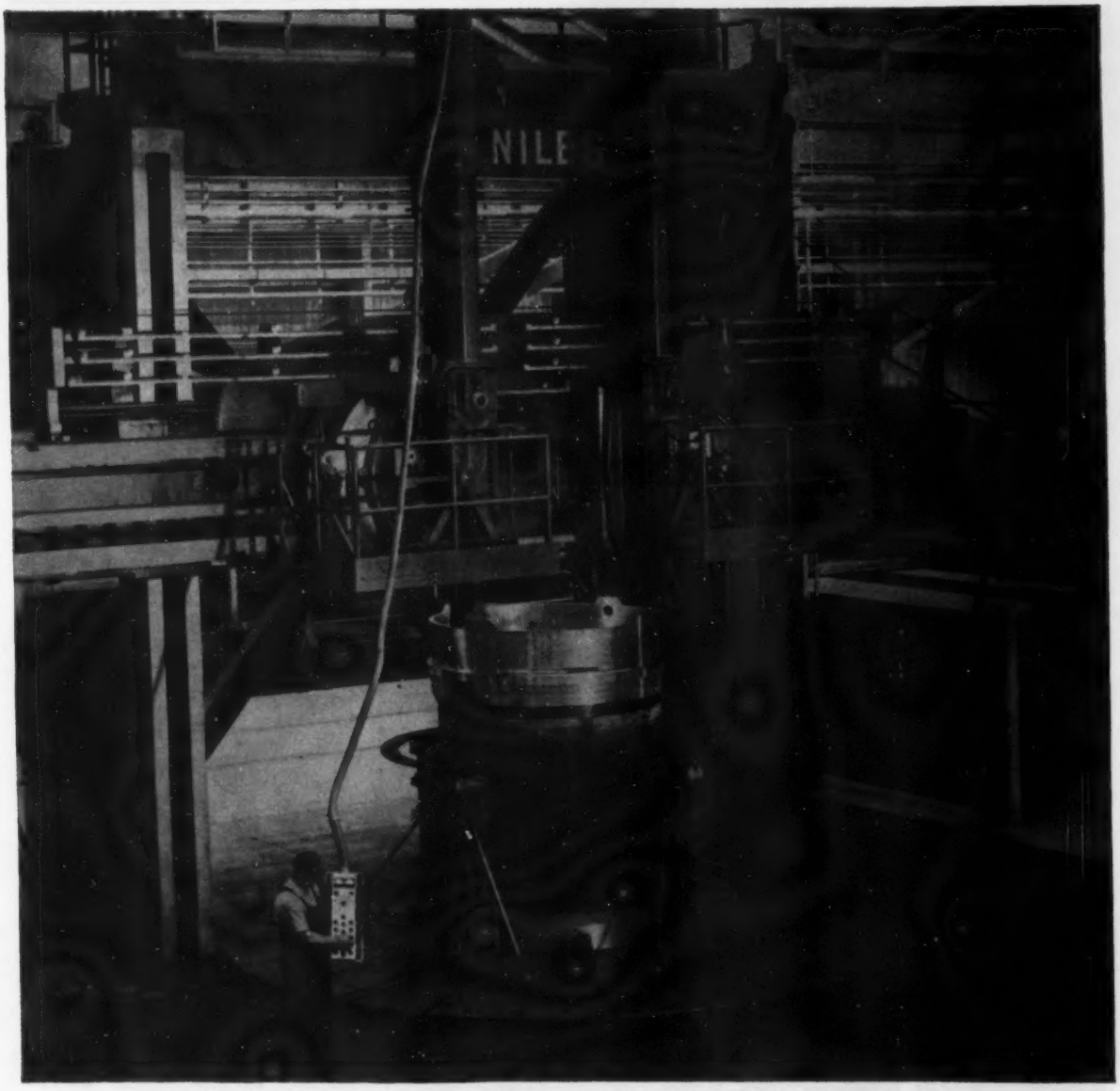
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

(Continued on page 256)



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GENERATORS, Electric
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Mummurt-Dixon Co., Hanover, Pa.
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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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Hammond Machinery Builders, Inc., Kalamazoo, Mich.
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Oliver Instrument Co., 1410 E. Maumee, Adrian Mich. (also drill point thinner)
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

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Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

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Chicago Pneumatic Tool Co., New York 17, N. Y.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., Niles, Ill.

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Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Elox Corp. of Michigan, Troy, Mich.
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Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.
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Leblond, R. K. Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
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Norton Co., 1 New Bond St., Worcester 6, Mass.
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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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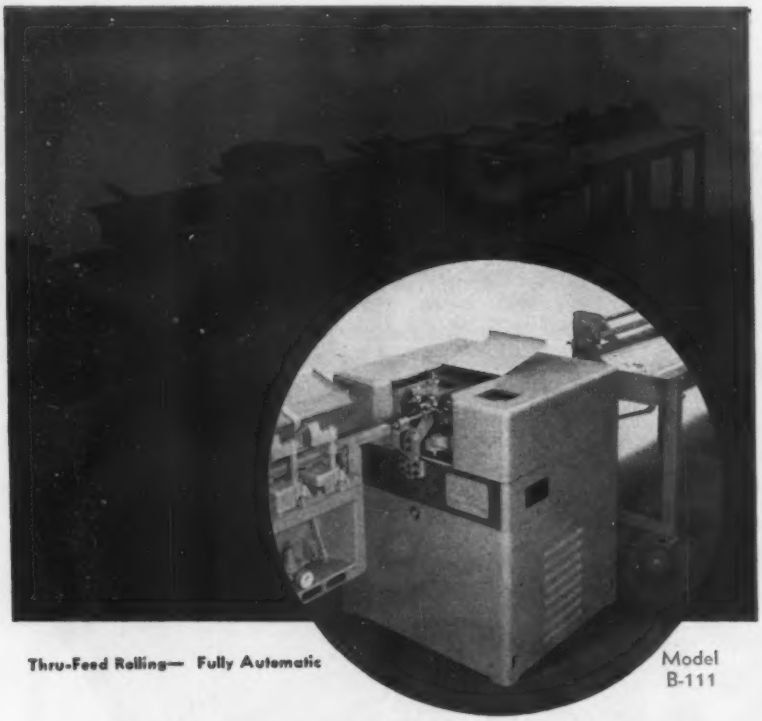

Thru-Feed Rolling— Fully Automatic

Model B-111

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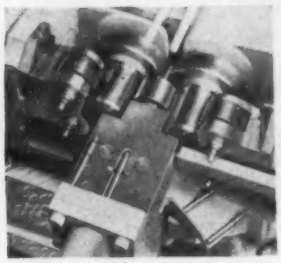

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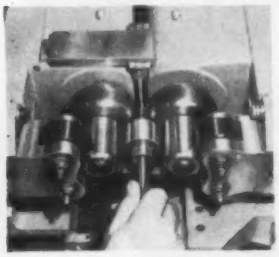

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Gallmeyer & Livingston Co., 338 Straight, S. W., Grand Rapids 2, Mich.
Hammond Machinery Builders Inc., Kalamazoo, Mich.
Landis Tool Co. Inc., Waynesboro, Pa.
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Norton Co., 1 New Bond St., Worcester 6 Mass.
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National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Typical Johnson valve tappet — cross section shows interrupted, semi-blind-end bore.

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Microhoning is a low-velocity abrading process that uses a combination of controlled speeds, feeds and motions to provide functional surfaces. Also, the large area of contact between abrasive and work surface spreads and easily dissipates the cutting heat. Thus, Microhoning generates clean-cut work surfaces that are free of burned or smeared metal.

Produces Longer-Wearing Surfaces

Because the Microhoned surface is cleared of amorphous material, it is in the base metal zone where longer-wear characteristics are more readily induced. Also, the unique Microhoning cross-hatch lay pattern provides a multitude of minute "plateaus" for equitable distribution of work load.

Two of the double-spindle Hydrohoners, each spindle has its own sizing control.

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Geometric accuracy is mandatory! For, there must be a clearance of .0002"-.0003" between tappet bore and its plunger. Microhoning consistently holds bores within the .00003" tolerance for roundness and straightness, and within .0005" for size. Proof—each tappet assembly must pass a critical "leak-down" test.

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In a typical production run of 31,250 parts, scrap was only three-tenths of 1%. This is a striking example of economy resulting from consistent quality processing. The use of Microhoning also eliminated previously required precision boring — several boring machines were involved in this saving.

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Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoALL Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
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Mattison Machine Works, Rockford, Ill
Norton Co., 1 New Bond St., Worcester 6, Mass.
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Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio.
Walker, O. S. Co., Inc., Worcester, Mass.

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Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W, Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
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Norton Co., 1 New Bond St., Worcester 6, Mass.
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Cincinnati Milling Machine Company, Cincinnati Milling Products Div., Marburg Ave. Cincinnati 9, Ohio
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HAMMERS, Portable Pneumatic
Chicago Pneumatic Tool Co., 6 E. 44th St. New York, N. Y.

HAMMERS, Power
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National Twist Drill & Tool Co. Rochester, Mich.
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Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
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HOW MICROHONING of Valve Tappet Bores Generates Accuracy Within .00003", Eliminates Boring, Cuts Scrap Losses

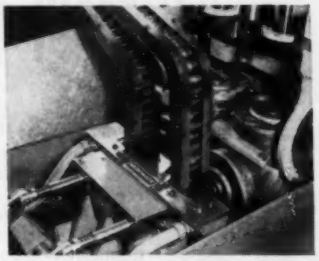
To obtain functional surface qualities, engineers at Johnson Products, Inc. are insisting on Microhoning the bores of hydraulic valve tappets designed for long service or punishing usage. In addition, here is how Microhoning also generates consistently high accuracy, eliminates an extra operation and reduces scrap losses to a minimum.

Automatic, Consistent Precision

Pictured is a line of four Model 738 Microhoners that typify the Microhoning equipment used by Johnson Products. Each machine has: automatic stonefeed and stonewear compensation (Microdial); automatic sizing unit (Gage Ring Air-Switch Microsize); air operated raising and lowering of fixture table assembly is synchronized with head controls for automatic operation.

Result: Johnson automatically obtains consistent precision as evidenced by these several facts. Microhoned bores are held within .00003" tolerance for roundness and straightness, within .0005" for size, and a specified surface finish of 12-14 microinches (rms) is generated. Also, from a typical production run of 31,250 parts, only three-tenths of 1% was scrap—a striking example of processing control and low scrap loss.

Flexible and Efficient Processing



Bore diameters of Microhoned tappets range from .656" to .800", and lengths from 1" to 2". Material is either cast iron, or iron alloy hardened to 55-60 R "C". In all, 15 different combinations of sizes and materials are Microhoned. Typical fixturing is shown to the right—it is designed to keep changeover time at a minimum.

From .004" to .005" stock is removed during the Microhoning cycle of 18 to 21 seconds. Cutting efficiency is boosted by the design of special Micromold tools. Intraflow features (within the tools) supply coolant directly to cutting zone.

We will gladly send more information on the Microhoning process and equipment—
WRITE FOR FREE LITERATURE

MICROMATIC HONE CORP.
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ALLEN

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Ever since Allen first produced the hex socket head screw nearly fifty years ago, specifying *genuine* Allens (made by Allen of Hartford) has been a sure way to guarantee dependable threaded fastening.

Only *genuine* Allens have Leader Points that make starting easier, and greatly minimize danger of cross threading. *Genuine* Allens are "pressur-formd" to preserve the long fibers uncut throughout the length of the screw, giving stronger sockets for greater tightening torque.

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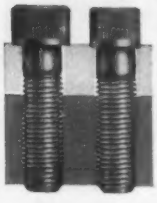
Allen's new 1960 Series Socket Head Cap Screws give up to 2½ times more load carrying capacity, without indentation. Head diameter of sizes from ¼" up is now uniformly 1½ times the body diameter—providing more under-the-head bearing surface, and a proportionate increase in clamping force. Write for new Bulletin G-25, with full specifications.



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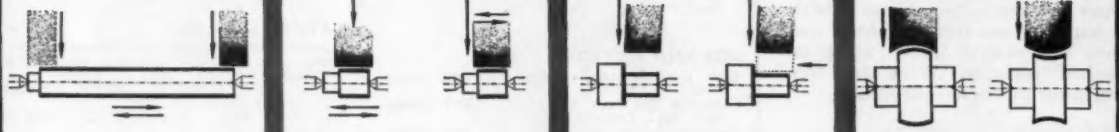
Model R4-500 U shown at left. Universal type, 10" swing, 24" center distance.



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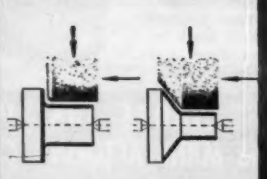

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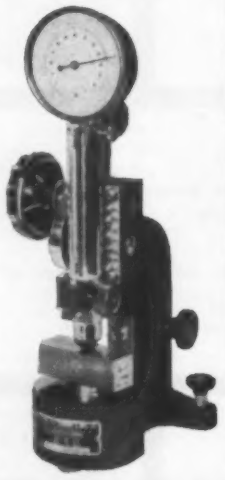
HARDNESS TESTING

Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.



Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 2½" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.

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(Continued on page 266)

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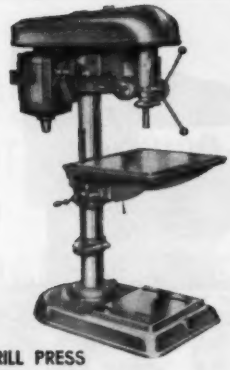

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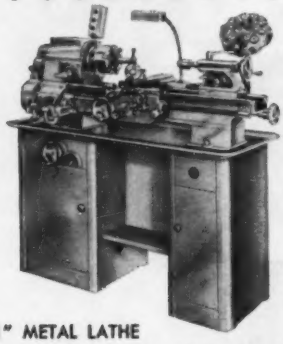

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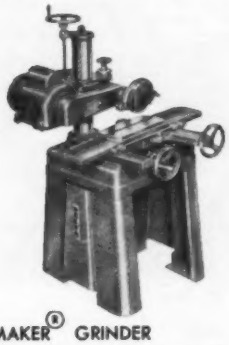

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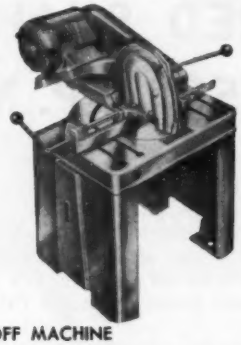

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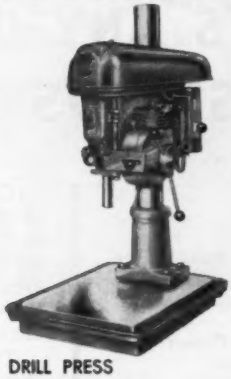

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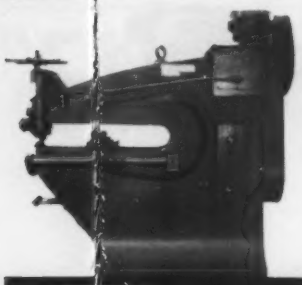

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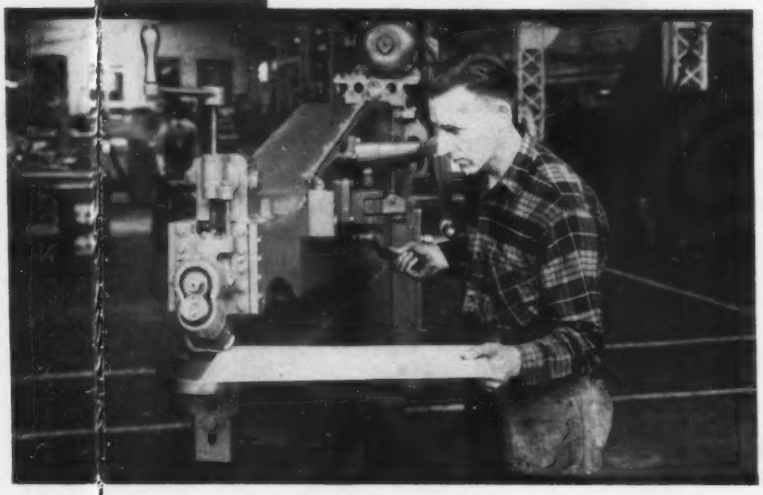
Rotary Shear Does the Work of 7 Machines



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- Gap Shears
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This Rotary Shear is a real cost-saver for almost any type of metal working shop — produces superior work fast, accurately, efficiently and actually eliminates the need for several other types of equipment.

Cut straight lines, openings, odd shapes, narrow strips, bevels and circles — also flanges or joggles . . . do them all faster, easier, more accurately with a Beatty-Quickwork Rotary Shear. It's the proven way to cut costs of metal fabrication.

This versatile shear cuts plate and sheet metal up to 1-inch mild steel. Unique inclined arrangement of cutter shafts and cutters facilitates shearing irregular shapes and straight lines with extreme accuracy. Only one operator is needed to perform most jobs. Thus, the rotary shear actually pays for itself in savings in equipment and floor space investment, manpower, increased output. Complete range of sizes.

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Sidney Mch. Tool Co., Sidney, Ohio
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LATHES, Gap

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LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sidney Machine Tool Co., Highland Ave., Sidney, Ohio
Springfield Machine Tool Co., Springfield, Ohio

LATHES Hollow Spindle

Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio

LATHES, Roll

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Bliss E. W., Co., Canton, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

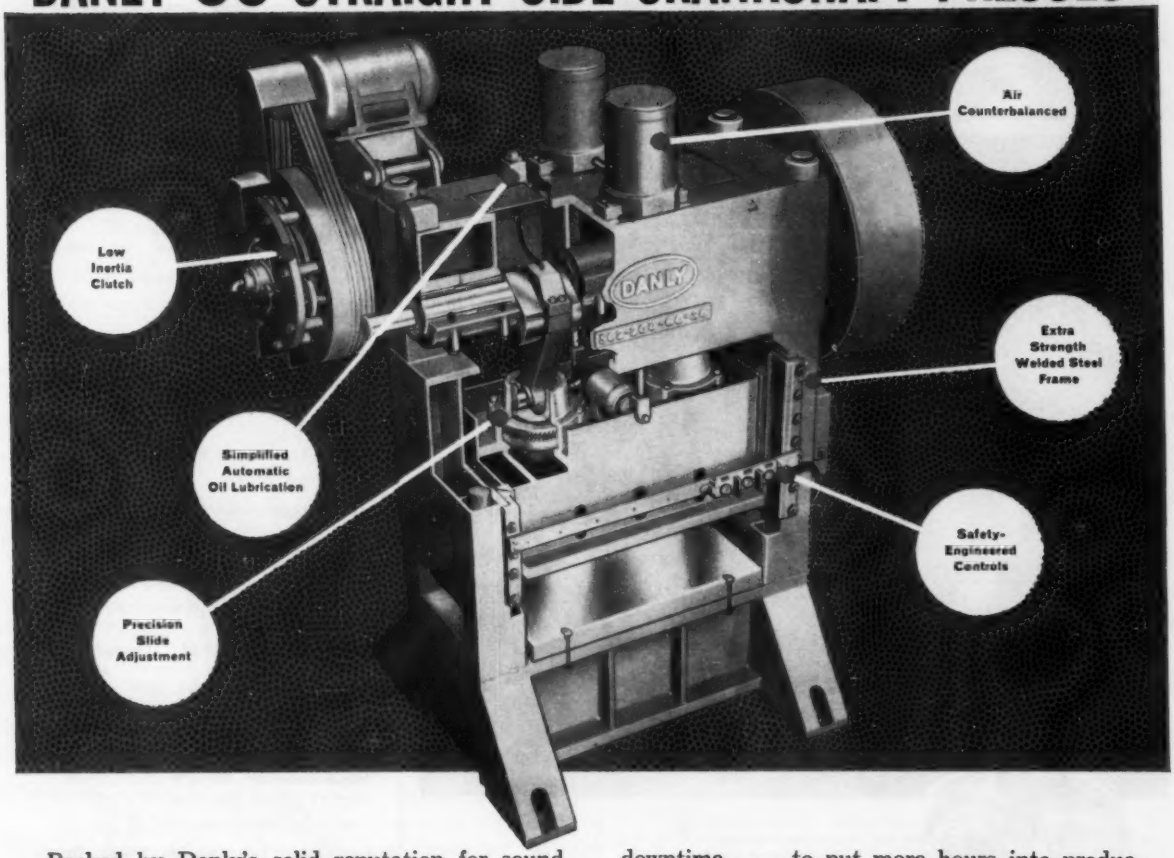
LATHES, Speed, Second-operation

Clausing Div, Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sideny, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning

Cincinnati Milling Machine Co., Meta-Dynamics Div., Marburg Ave., Cincinnati 9, Ohio (Hydrospin)
Cosa Corp., 405 Lexington Ave., New York 17
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

YOU GET STANDARD-DESIGN ECONOMY, CUSTOM-BUILT FEATURES WITH DANLY SC STRAIGHT SIDE CRANKSHAFT PRESSES



Backed by Danly's solid reputation for sound design and quality construction, Danly Series SC Presses offer pre-engineered, standardized design, to assure economy for general stamping work. At the same time, they offer outstanding features normally found only on custom-built presses.

Like all Danly Presses, the SC's have husky, rigid frames, to deliver accurate die closure with minimum deflection . . . which means longer die life. Automatically lubricated, quiet, smooth-running drive guarantees longer press life. Every detail of the Danly SC line has been engineered to shrink downtime . . . to put more hours into production time.

Series SC Presses are available in capacities from 50 to 300 tons. Roll feeds and variable speed drives are available for completely automatic, high-production operation.

WRITE FOR NEW CATALOG. Gives full details on Danly low-maintenance, air-friction clutch, and other features. Lists full specifications. Ask for Bulletin SC.

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LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic
Bullard Co., Bridgeport 2, Conn.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1160 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES, Turret, Ram Type, Saddle Type
Bardons & Oliver, Inc., 1133 W. Ninth St., Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Lapointe Machine Tool Co., Hudson, Mass.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.

LEAD SCREWS & SPLINES, Ball Bearing
Saginaw Steering Gear Div. General Motors Corp., Saginaw, Mich.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Cities Service Oil Co., 70 Pine St., New York N. Y.
Lubriplate Div., Fiske Bros. Refining Co., 129 Lockwood St., Newark 5, N. J.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Chicago, Ill.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St. Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17 N. Y.

LUBRICATING SYSTEMS
Madison-Kipp Corp., Madison, Wis.
Trabon Engineering Corp., Solon, Ohio

MACHINERY, Used and Rebuilt
Eastern Mchry Co., 1000 Tennessee Ave., Cincinnati, Ohio
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Motch & Merryweather Mchry. Co., 888 E. 70th St., Cleveland 3, Ohio
Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Pannier Corp., 319 Pannier Bldg., Pittsburgh 12, Pa.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MEASURING WIRES, Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

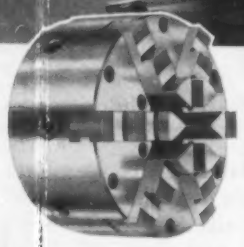
MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Slocomb, J. T. Co., Glastonbury, Conn.
Van Keuren Co., 176 Waltham St., Watertown 12, Mass.

MICROSCOPES, Toolmakers'
DoALL Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St. New York 12, N. Y.

MILLING MACHINE ATTACHMENTS
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
(Continued on page 270)

"You make money every time you chuck with *Buck*"



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Buck originated the 6-jaw Ajust-Tru® chuck and, though others have tried, none can equal the Buck in precision with speed.

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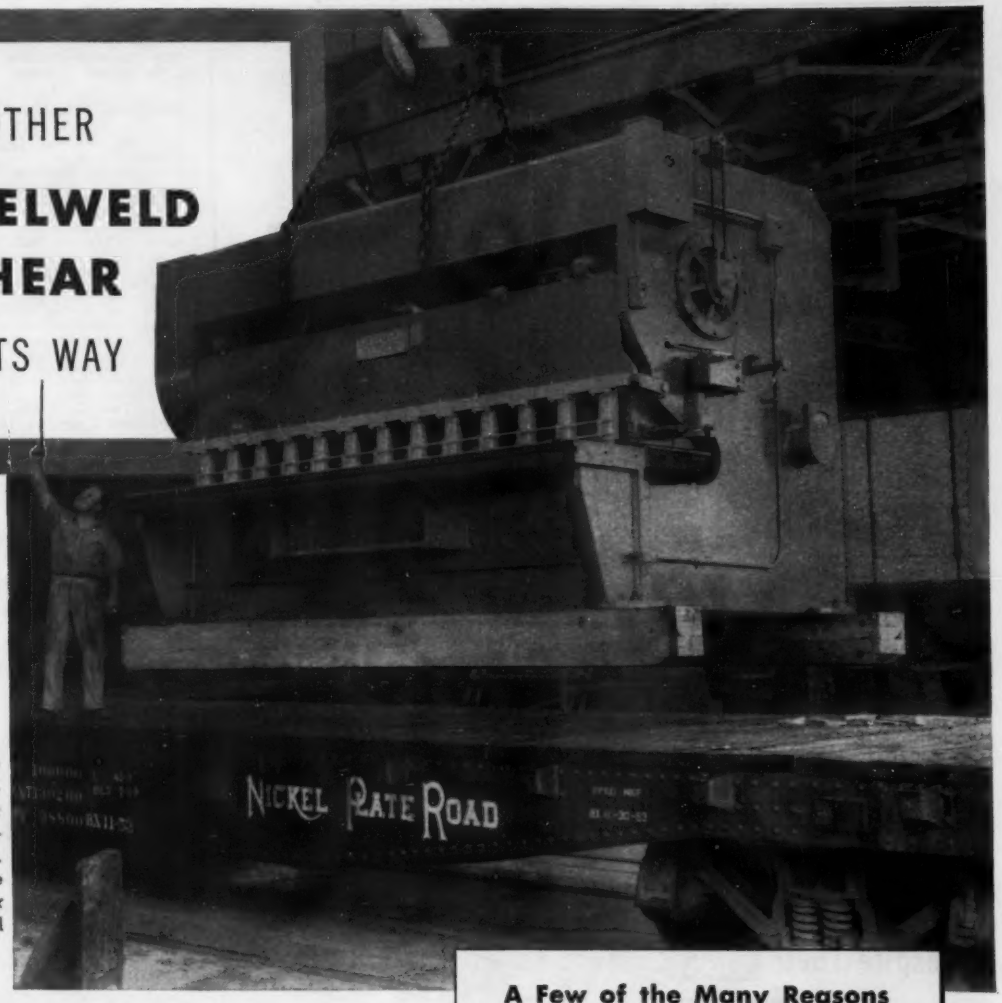
ANOTHER

STEELWELD SHEAR

ON ITS WAY



From every angle a Steelweld shear looks good — and is good. This machine is rated for 12'-0"x½"steel

SHIPMENTS are being made at a rapid rate to all parts of the country because more and more users are learning of the many merits of Steelweld Shears and are talking about them. As the words of experience spread about and comparisons are made, more and more people come to realize that Steelweld Shears are really outstanding.

For smooth, accurate burr-free cutting, Steelwelds can't be beat. For ease of operation they have no peer. Their heavy construction and means for simple, easy maintenance assure long trouble-free life.

Regardless of the type shear most suitable for your requirements — mechanical or hydraulic — you cannot make a better selection than Steelweld.

A Few of the Many Reasons For STEELWELD'S DEMAND

1. Pivoted-blade operation. Entirely different from every other shear. No slides or guides to wear and cause inaccuracies.
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4. Accurate easy operating back gauge rides on ball bearings.
5. Low knife rake angle enables finest cuts for every thickness.
6. Heavy steel frame assures permanent accuracy.

AVAILABLE FOR PLATE LENGTHS TO 30 FEET AND THICKNESSES TO 2 INCHES

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PIVOTED BLADE MECHANICAL and HYDRAULIC **SHEARS**

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Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.

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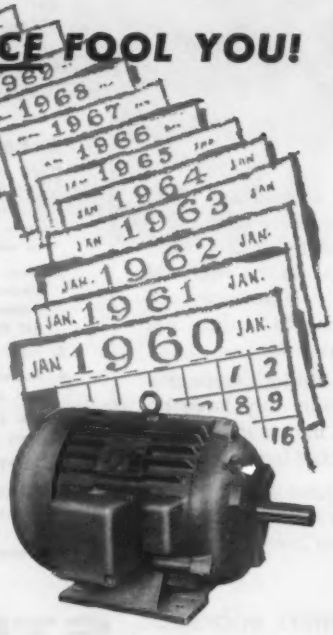

Anybody who knows motors will recognize that there is no finer motor than the Brook. These motors have established excellent service records in industry. Yet, they actually cost less!

Space age production methods and extensive distribution in 76 countries makes possible this better motor at lower cost. All standard enclosures. 1 to 600 H.P. Start saving now—look into Brook Motors at once. Write for literature and name of your dealer.

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3302-04 W. Peterson Ave., Chicago 45, Ill.

Factory Representatives, Warehouses, Dealers, Service Stations, in Major Cities
In Canada: Brook Electric Motors of Canada Ltd., 250 University Ave., Toronto, Ont.

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Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Austin Industrial Corp., White Plains, N. Y.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Marac Machinery Corp., Yonkers, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Pratt & Whitney Co., Inc., W. Hartford, Conn.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island 1, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Pratt & Whitney Co., Inc., W. Hartford, Conn.
Sundstrand Mch. Tol Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Austin Industrial Corp., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio

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means precision
where you need it most
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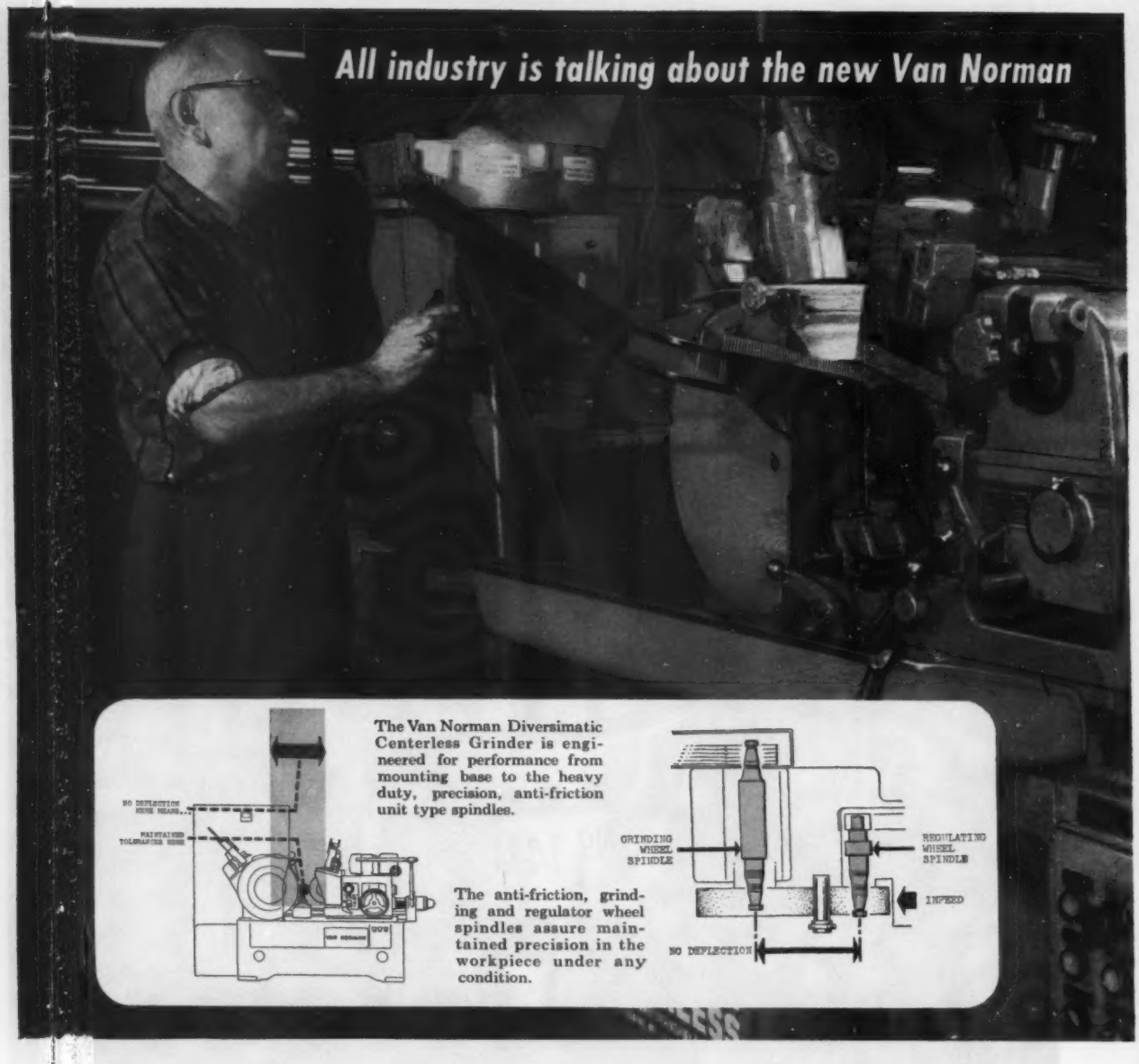


The Van Norman Diversimatic Centerless Grinder is engineered for performance from mounting base to the heavy duty, precision, anti-friction unit type spindles.

The anti-friction, grinding and regulator wheel spindles assure maintained precision in the workpiece under any condition.

BENDIX AVIATION BOOSTS SYNCRO SHAFT

VN Centerless Grinding cuts production operations, inspection time and

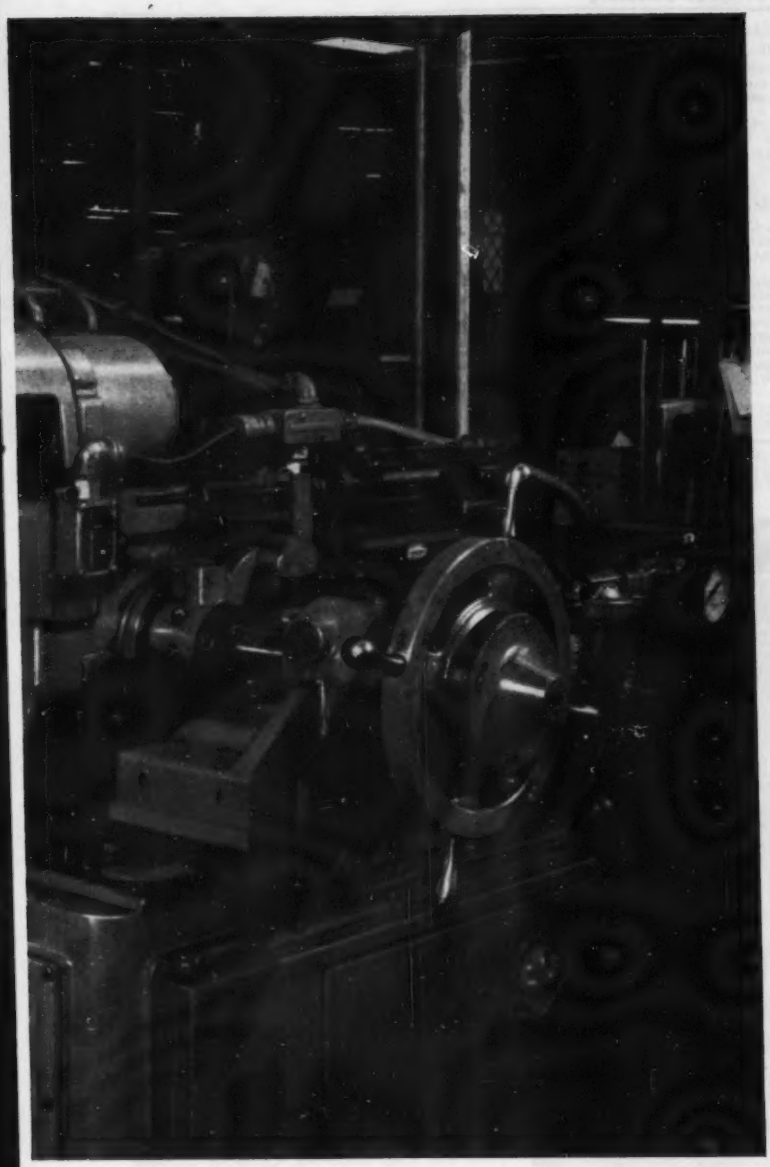
Bendix boosted hourly production of Autosyn syncro shafts to 600 per operator with a Van Norman Centerless Grinder. One Van Norman Centerless Grinder (with a specially developed automatic feed) replaced two manually fed machines, which produced only 50 shafts per hour.

Annual Savings $9,000—eliminating the need for highly skilled burnishing operators—100% inspection was eliminated. Concentricity control and improved tolerances were obtained with the Van Norman Centerless Grinder.

Faster Set-Ups . . . Increased Production . . . Greater Accuracy. The Van Norman Centerless Grinder is specifically engineered to produce more precision grinding per operator per work shift . . . designed for in-feed work,

VAN NORMAN

SPRINGFIELD 7, MASSACHUSETTS



PRODUCTION 1200%

material cost — saves $9,000 annually

thru-feed work, crush form grinding and profile work. The Van Norman Centerless Grinder is rugged, and designed for heavy duty, long run production.

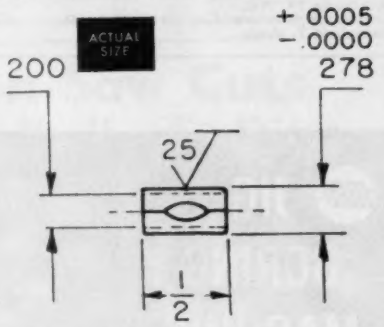
Send For Free Booklet—"Centerless Grinding," your local VN Franchised Distributor will be happy to discuss how VN Centerless Grinding may increase production and cut costs for you . . . call him NOW!

MACHINE COMPANY

A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

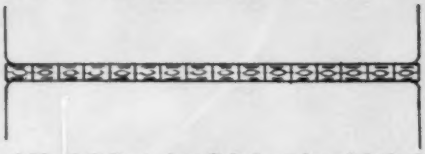
Another typical Van Norman centerless grinder cost-saving application

CUSTOMER'S PROBLEM:



Grind the .278″/.2785″ with an RMS of 25, or better, at a rate of 300 or more pieces per minute. The parts are rolled seamed carbon steel hardened to 56-58 Rockwell C. Machine to be hopper fed. Size to be held whether wheels are full of parts or scattered.

VAN NORMAN SOLUTION:



A No. 2-C Centerless Grinder using eight inch face wheels and vibratory hopper with a maximum feed rate of 410 pieces per minute was used. A P & W Air Gauge set limits of high and low to .0003″ or .0002″ less than allowed.

THE RESULT:

Van Norman ground 250 lbs. of parts—or 60,000 pieces—at 410 pieces per minute. Faster time was possible but the hopper could not handle a faster rate. All of the parts were ground without redressing the wheels. Size was held to well within the .0003″ allowable limits. Finish held to less than 15 RMS. Variation from piece-to-piece was not discernible. Wheel wear required a .0001″ compensation every five minutes to keep the .00025″ tolerance.

Customer reaction: complete satisfaction.

2234

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Clearing Div., of U.S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greenes Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., Niles, Ill.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Austin Industrial Corp., White Plains, N. Y.
Bridgeport Mchs., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 11110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Planer Type

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker, Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

MOTORS, Electric

Brook Motor Corp., 3302 W. Peterson Ave., Chicago 45, Ill.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland 17, Ohio
Onsrud Machine Works, Inc., Niles, Ill.
Reliance Electric & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

MOTORS, Hydraulic

Barnes, John S. Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE STATION MACHINES, Dial Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.

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Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
National Automatic Tool Co., S. 7th N. St., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch., Tool Co., 2531 11th St., Rockford, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

NIBBLERS, Portable Pneumatic
Buckeye Tools Corp., Dayton, Ohio

NIBBLING MACHINES
American Pullmax Co., Inc., 2455 N. Sheffield Ave., Chicago 14, Ill.
Wales-Strippit, Inc., Akron, N. Y.

NICKEL & NICKEL ALLOYS
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.

NUMERICAL CONTROL SYSTEMS—See Electronic Control Systems

NUT SETTERS—See Screwdrivers, etc.

NUTS—See Bolts, Nuts and Screws

OIL GROOVERS
Wicaco Machine Corp, Wayne Junction, Philadelphia 44, Pa.

OILERS AND LUBRICATORS
Madison-Kipp Corp., Madison, Wis.
Wicaco Machine Corp, Wayne Junction, Philadelphia 44, Pa.

OILS, CUTTING SOLUBLE—See Cutting and Grinding Fluids

OILS, Lubricating—See Lubricating Oils and Greases

OILS, Quenching and Tempering
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 - 5th Ave., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.

OPTICAL FLATS
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

PAINTING EQUIPMENT, Spray—See Spraying Equipment, Metal

PARALLELS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., De Plaines, Ill.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, Wood and Metal
Mummert-Dixon Co., Hanover, Pa.

PILLOW BLOCKS
S K F Industries, Inc., Philadelphia, Penna.

PIPE, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa
Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co. Div., 436 7th Ave., Pittsburgh, Pa.

PIPE AND TUBING MILLS, Electric-weld
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

PIPE AND TUBING, Brass and Copper
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Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.

PIPE THREADING AND CUTTING MACHINES
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Landis Machine Co., Inc., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio

PLANER JACKS—See Set-up Equipment

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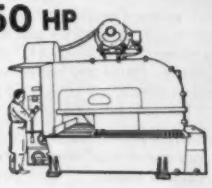

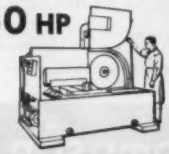

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Consolidated Mch. Tool Div., Rochester, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A. Co., 3611 Woodburn Ave., Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Lapointe Machine Tool Co., Hudson, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

PLASTICS AND PLASTIC PRODUCTS
Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
U. S. Steel Corp., Nat'l Tube Div., Pittsburgh, Pa.

PRESS BRAKES—See Brakes, Press and Bending

PRESS FEEDERS, Automatic
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

PRESSES, Arbor
Birdsboro Corp., Birdsboro, Pa.
du Mont Corp., Greenfield, Mass.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha, Wis.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.
Wilson, K. R., Inc., Arcade, N. Y.

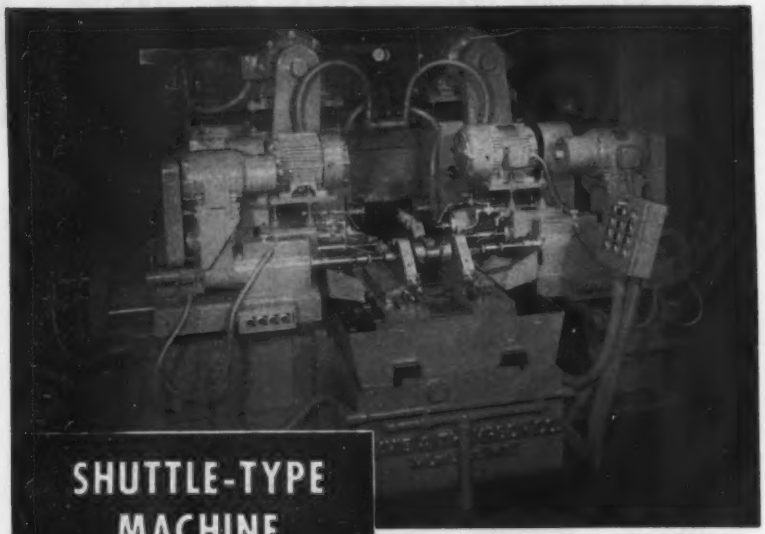
PRESSES, Assembling
Allen, Alva Industries, Clinton, Mo.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Northern Hydraulics & Mach. Corp., Melrose Park, Ill.

PRESSES, Blanking, Stamping
Allen, Alva Industries, Clinton, Mo.
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering Div. American Brake Shoe Co., 152 Dublin Rd., Columbus 16, Ohio
Federal Machine and Welder Co., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach.. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Briquetting
Birdsboro Corp., Birdsboro, Pa.
Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Closed-Die Forging
Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Coining, Embossing
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine and Welder Co., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave. Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.



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Here's a good example of engineering a semi-standard machine to handle a lot of parts. Although this machine has been adapted to milling, centering, drilling and tapping of valve parts, its basic design lends itself to other operations through the addition of various types of heads as well as multiple spindle drill heads. Machine incorporates hydraulic controls for table feed and index, two milling heads, two hydraulic power heads, each with center drill and tap drill spindle, and two mechanical screw feed tapping heads to accommodate 16, 20 and 24 pitch threads. Capacities range from ⅜" to 4½" diameter, 5" to 23" long. Parts are inner valves for liquid level controls of tough #316 stainless steel.

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Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Die Tryout
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Machine and Welder Co., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Drawing
Allen, Alva Industries, Clinton, Mo.
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Machine and Welder Co., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
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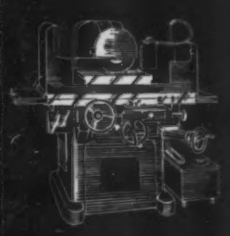

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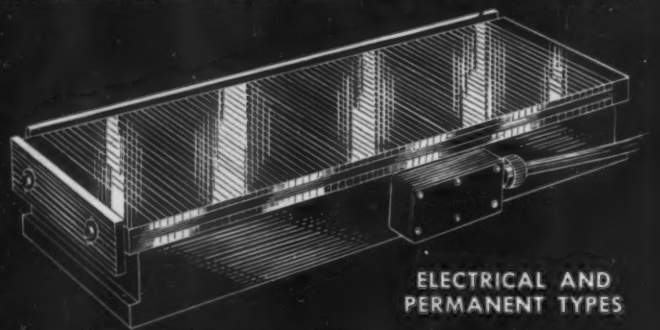

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Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine and Welder Co., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Foot
Famco Machine Co., Kenosha, Wis.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Horning
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine and Welder Co., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Notching
Allen Alva Industries, Clinton, Mo.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Federal Machine and Welder Co., Warren, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing
Allen, Alva Industries, Clinton, Mo.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
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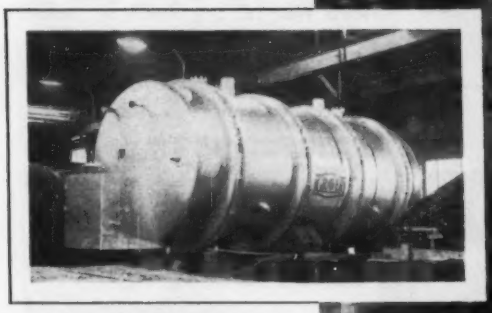
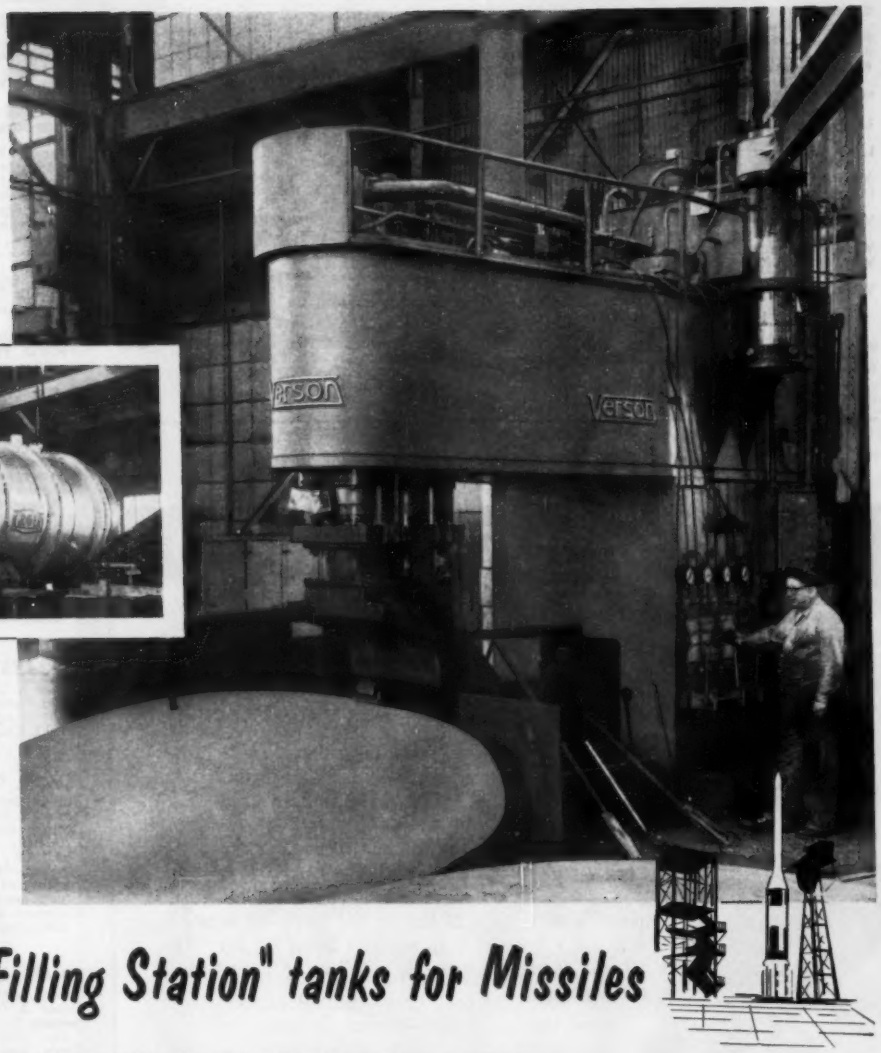
(Continued on page 280)



Above—5300 gallon capacity liquid oxygen storage tank fabricated by Graver Tank & Manufacturing Co., Inc. It consists of an outer vacuum shell of carbon steel plate and inner shell of stainless steel for service at –297° F.



How to make "Filling Station" tanks for Missiles

Graver flanges 11′ heads for liquid oxygen tanks in -Verson- flanging press

If you should ever want to make a tank for holding liquid oxygen, you'll find it takes a lot of know-how plus the right kind of equipment.

Graver Tank & Manufacturing Co., Inc., Division Union Tank Car Company, is a century old fabricator who knows the importance of good equipment. The Verson 375 ton hydraulic flanging press shown above is a good example.

Installed at Graver's East Chicago, Indiana, plant, it is shown flanging the 11′ diameter 3/8" ASME carbon steel heads for the outer shell of liquid oxygen storage tanks. Stainless steel heads for an inner shell are also fabricated in the press. The press has two vertical rams and one horizontal ram, each of 125 tons capacity plus a bed cylinder of 125 tons capacity. All are individually controlled.

Even though liquid oxygen tanks are not your line, you should take advantage of Verson's experience for all your metal forming requirements. Verson's experience is broad and intensive, your best assurance of getting the kind of help you need. For specific recommendations, send an outline of your requirements.

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Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave Chicago 19, Il.
Wales-Strippit, Inc., Akron, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Quenching

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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Rubber-Forming

Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling Machine Co., Meta-Dynamics Div., Cincinnati 9, Ohio (Hydroform)
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg Co., Mount Gilead, Ohio
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9303 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Trimming

Allen Alva Industries, Clinton, Mo.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Corp., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
B-T Machinery Co., Holland, Mich.
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Il.
Cleveland Punch & Shear Wks., Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
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Federal Machine and Welder Co., Warren, Ohio
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L & J Press Corp., 1631 Sterling Ave., Elkhart Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoALL Co., Des Plaines, Ill.

PUMPS, Coolant and Lubricant

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., Des Plaines, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio

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Barnes John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

PUNCHES AND DIES—See Dies, Blanking, etc.

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Cogsdill Twist Drill Co., Greenfield, Mas.
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Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
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Tomkins-Johnson Co., Jackson, Mich.

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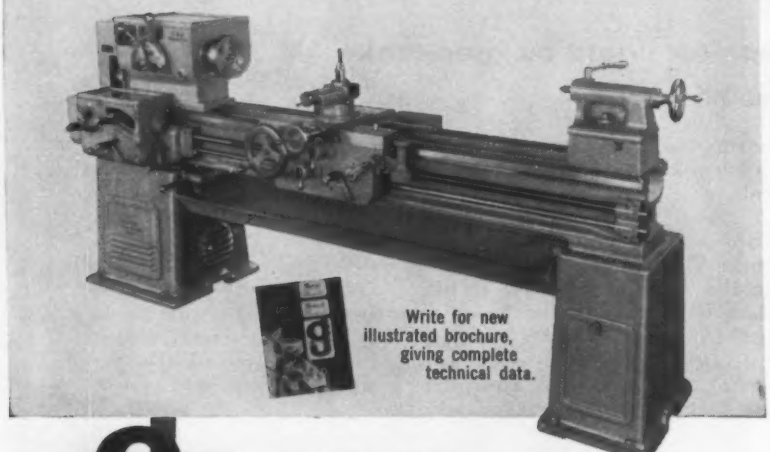

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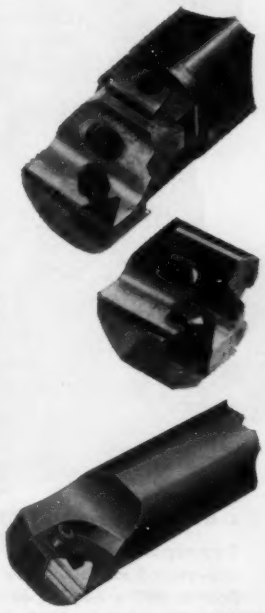

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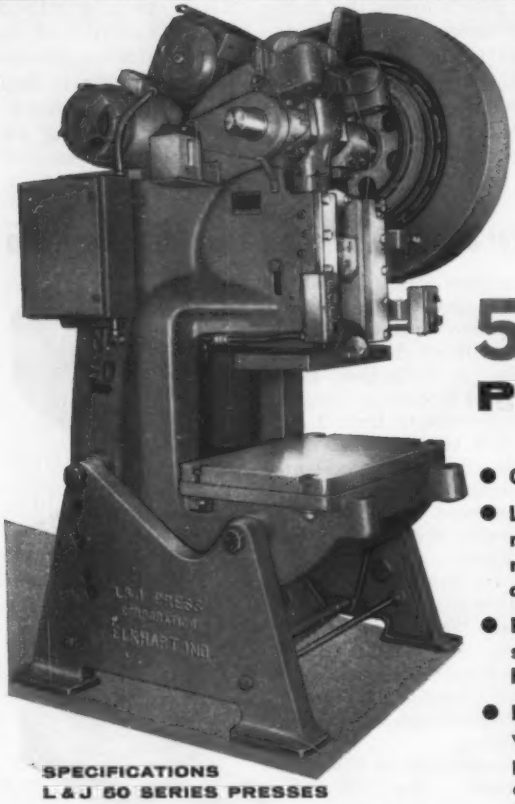

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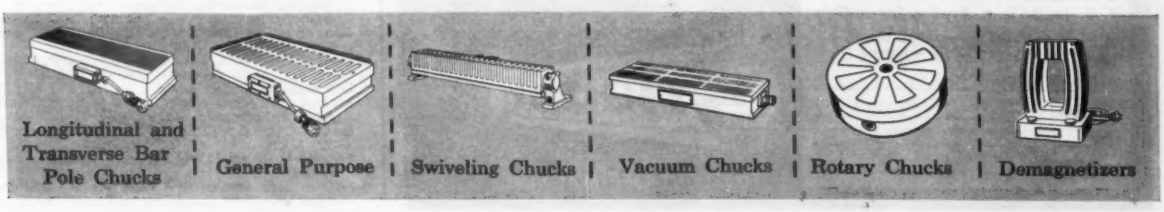

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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

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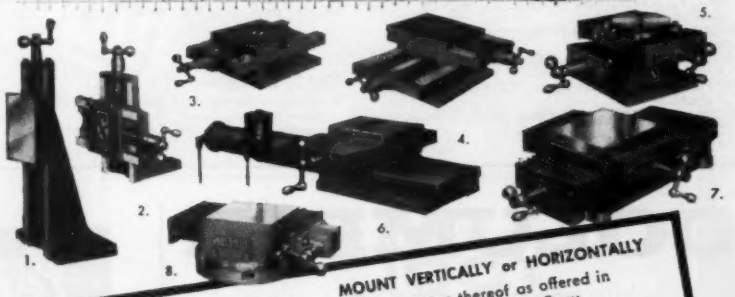

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ANGLE PLATE MOUNTING: Fig. 1 with Vertical Feed. Fig. 2 with Vertical and Horizontal Feed.

BASE MOUNTING: Fig. 3 with Horizontal Feed. Figs. 4, 5, 6 and 7 with Compound Feeds.

AVAILABLE ON ANY FEED: Power Cylinders (Figs. 6, 10 and 11); Accordion Protectors (Figs. 5, 7 and 8); Right Angle Feeds (Figs. 8 and 9); 360° Swivel Work Base (Fig. 5); 360° Mounting Base (Figs. 8, 9, 11, 12 and 13).

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SURFACE PLATES
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.

SWAGING MACHINES
Cincinnati Milling Machine Co., Meta-Dynamics Div., Cincinnati 9, Ohio (Intraform)

SWITCHES, Limit
Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

TACHOMETERS—See Indicators, Speed

TAPE CONTROL SYSTEMS—See Electronic Control Systems

TAP HOLDERS
Brown & Sharpe Mfg. Co., 235 Promenade St. Providence 1, R. I.
Burgmaster Corp., 15001 S. Figeroa, Gardena, Calif.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.

TAPPING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Jarvis Corp., Stack Ave., Middletown, Conn.
Kato Mfg. Co., Osaka, Japan.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1014 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Cal.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta. Detroit 5, Mich.
Edlund Machinery Co., Cortland, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaufman Manufacturing Co., Manitowac, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Landis Mch. Co., Waynesboro, Pa.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 2, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPS, Hand, Machine Screw, Pipe, etc.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

TAPS, Collapsing
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.

TESTING EQUIPMENT Air, Oil & Water Pressure
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

THREAD CUTTING MACHINES
Davis & Thompson Co., 4460 W. 124th St., Milwaukee 10, Wis.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46. Ill.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio.
National Machinery Co., Tiffin, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
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TOOL HOLDERS
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Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

TOOL MATERIAL, Ceramic
Metal Carbides Corp., Youngstown 12, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Crucible Steel Co. of America, P. O. Box 2518, Pittsburgh 30, Pa.
du Mont Corp., Greenfield, Mass.
Jessop Steel Co., Washington, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

TRACING ATTACHMENTS
American Tool Works Co., Pearl & Eggleston Aves., Cincinnati 2, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit, Inc., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

TRANSFER MACHINES
See Multiple-Station Machines

TRANSMISSION, Variable Speed
Barnes, John S. Corp., Rockford, Ill.
Boston Gear Wks., Quincy, Mass.
Cleveland Worm & Gear Co., 3249 E. 80th St., Cleveland 4, Ohio
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus, Ohio.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

TRUCKS, Material Handling
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.

TUBE-FLANGING MACHINES
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.

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Yoder Co., 5504 Walworth Ave., Cleveland, Ohio.

TUBE MILLS
Yoder Co., 5504 Walworth Ave., Cleveland, Ohio.

TUBING, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Crucible Steel Co., of America, P. O. Box 2518, Pittsburgh 30, Pa. (Titanium, Zirconium)
Mueller Brass Co., Port Huron 34, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

TUBING, Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Crucible Steel Co., of America, P. O. Box 2518, Pittsburgh 30, Pa. (Stainless & High Alloy)
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio

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ULTRASONIC MCH. TOOLS
Sheffield Corp., Box 893, Dayton 1, Ohio.

VALVE CONTROLS
Barnes, John S. Corp., Rockford, Ill.
Logansport Mch. Co., Inc., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VALVES, Air
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind.
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
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Tomkins-Johnson Co., Jackson, Mich.

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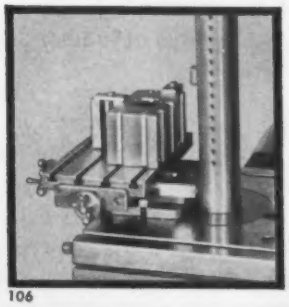
Right: Set-up for internal cutting
Below: Set-up for external cutting



106

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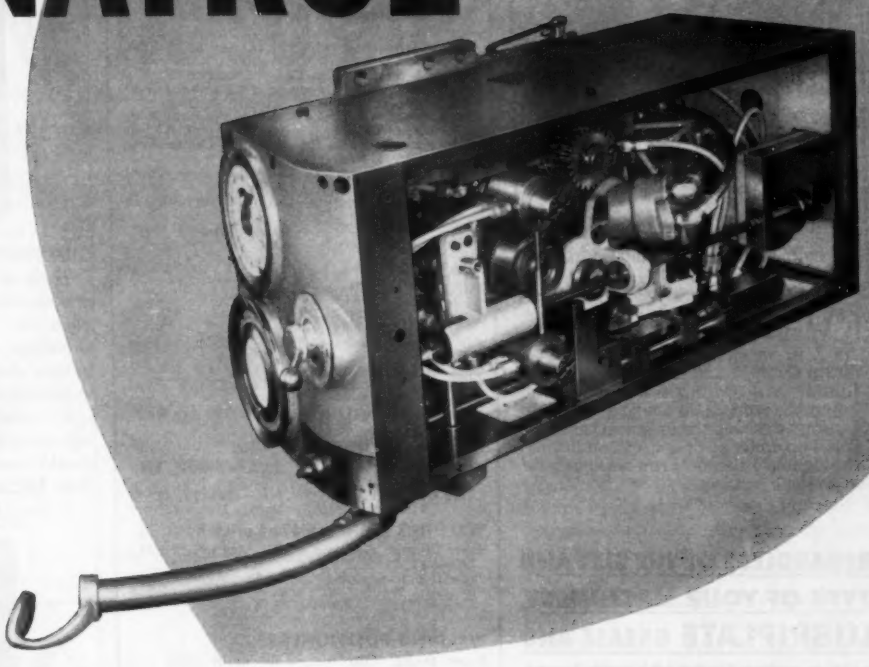
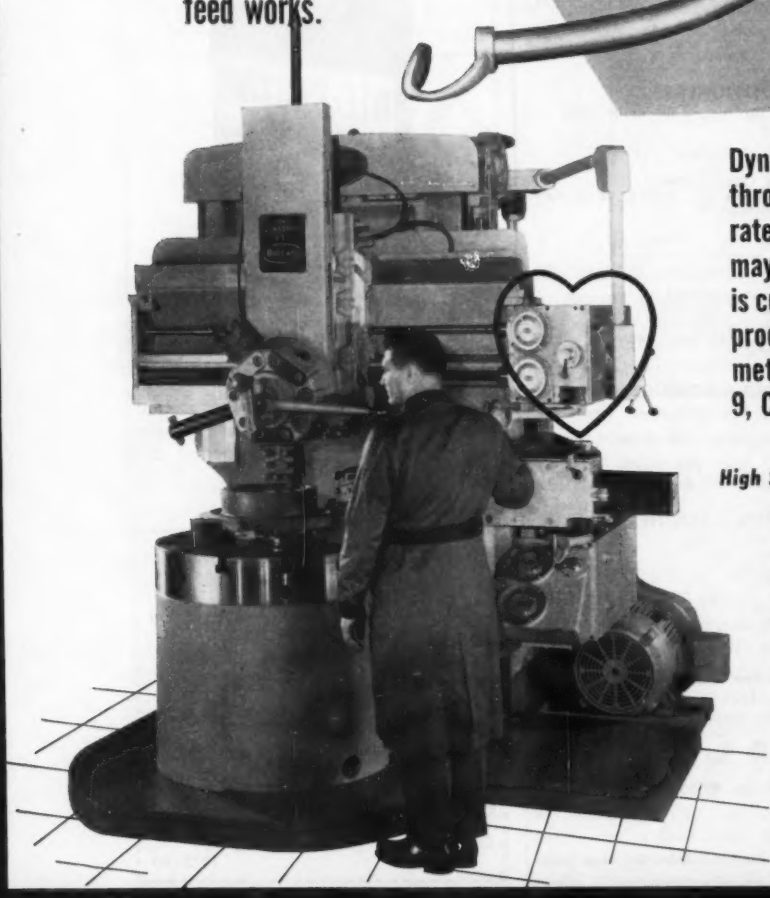
By means of a single lever or from a simple remote control all head motions, traverse and feed engagement are accomplished through this revolutionary new feed works.





Dynatrol* provides infinitely variable feed rates throughout the full range and variable traverse rates from zero to nine feet per minute. Feed rates may be advanced or retarded while the machine is cutting to obtain maximum tool performance and productivity. Ten sizes from 26" to 144" table diameter. Send to The Bullard Company, Bridgeport 9, Conn. for complete catalog.

High Spot Features of the Dynatrol* V.T.L. include:

VERSATILITY

Available equipment includes: Bullard variable speed drive for infinitely variable table speeds throughout the full range with no loss of usable horsepower. Fully automatic operation by Bullard Man-Au-Trol or point-to-point or continuous path numerical control systems.

Unique Size-Au-Trol* for accurate positioning of all heads. Contouring attachments: Hydraulic, electronic or electro-hydraulic. Four of five-sided power-indexing turret heads. Thread cutting, drum scoring and angle turning attachment. Power-operated chucks.

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The new Bullard Dynatrol V.T.L. is compact in design, rigid in construction, lower in height, reduced in floor area.

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VALVES, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio.
Logansport Machine, Inc., 810 Center Ave., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VERNIERS—See Calipers, Vernier; Gages, Vernier

VISES, Machine
Austin Industrial Corp., White Plains, N. Y.
Bridgeport Mches, Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

WAY COVERS
Futurmill, Inc., Pontiac, Mich.

WELDING EQUIPMENT, Arc
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Gas
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Resistance
Eisler Engrg. Co. Inc., 750 South 13th St., Newark, N. J.
Federal Machine and Welder Co., Warren, Ohio
Precision Welder & Flexopress Corp., 3518 Ibsen Ave., Cincinnati 9, O.

WELDING POSITIONERS
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.

WELDMENTS
Bliss, E. W., Co, Canton, Ohio.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

WIRE
Allegheny Ludlum Steel Corp., Pittsburgh, Pa (Stainless)
Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co., of America, P. O. Box 2518, Pittsburgh 30, Pa. (Stainless Titanium)
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.

WIRE FORMING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Eisler Engrg. Co., Inc., 750 South 13th St. Newark, N. J.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

WOODWORKING MACHINES
Clausing Div., Atlas Press Co., Kalamazoo Mich.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.

WRENCHES, Allen, End, Socket, Adjustable, etc.
Allen Mfg. Co., Bloomfield, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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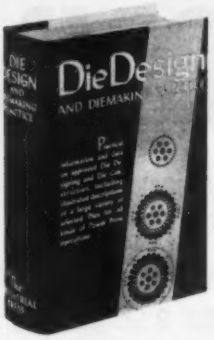

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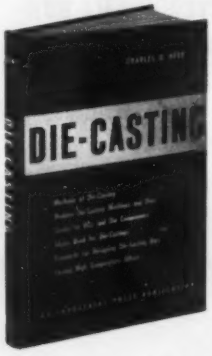

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PRECISION Quarterly NUMBER 1

PRECISION WELDER AND FLEXOPRESS CORPORATION, 3520 Ibsen, Cincinnati 9, Ohio

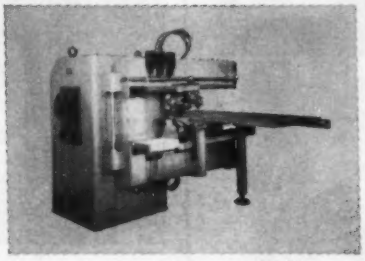
GOLDMINE IN SCRAP

Butt-seam welding process saves $70,000 in one year on one automotive stamping

EVERY TIME the automotive industry uses a ton of sheet steel, 35 per cent of it becomes scrap. What a saving if some of it could be easily joined into bigger pieces from which parts could be blanked or drawn, just like from virgin metal!

If you've been following the industrial news, you know this is no pipe dream. A machine to make useful pieces out of scrap has been perfected and is about to be installed in one of the country's largest automobile plants. That company predicts a saving of $70,000 a year on one automobile stamping alone:

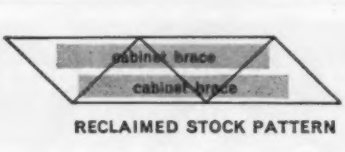
The machine is the Precision Butt-Seam Welder, a standard machine that



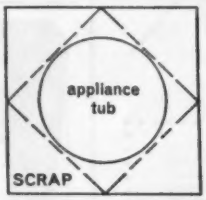
is easily adaptable to a great variety of scrap reduction programs. It butt welds sheet steel—mild, low alloy, high carbon or stainless—by the Peco butt-seam welding process.

The Precision Butt-Seam Welder can join pieces of metal edge to edge as fast as 24 feet per minute. The butt weld is made between foil strips of parent metal which increase resistance and contain the weld, so that it turns out scarcely thicker than the original sheet (approximately 10 per cent). You can deep draw a welded piece without cleanup, or dress the weld with a light grind for a smooth one-piece look.

Companies which generate a lot of flat scrap—automobile plants, appliance makers, large stamping shops—will find this unique welder especially useful. The sketch above gives just a hint of how an appliance maker might use metal he formerly had to scrap. You can find a dozen similar examples around almost any stamping shop, all of them representing dollars going to waste.



RECLAIMED STOCK PATTERN



Suppose you wanted to stamp out a part that looked like Oklahoma. No matter how you arranged it on the strip, you'd have lots of scrap. But suppose you blanked out the bulk of the state from one strip and the panhandle from another, and then butt-seam welded the two parts together. You'd cut your scrap in half—maybe more, your welded parts would be absolutely as good as those made of one piece, and your original metal costs would be far less!

For companies who want to stamp Oklahomas (or anything else) and save, we will be glad to supply any number of Precision Butt-Seam Welders. Also advice, know-how, service, and Precision Flexopresses to do the stamping.

Stock Jams Ended

A SIMPLE DEVICE, no bigger than a couple of decks of playing cards, is protecting presses these days from the dangers of overload. If an extra thickness of stock enters the die, this device stops the press.

So do lots of other safety stops, but this one is different. It isn't affected by current variations, or vibration, because it doesn't operate by those principles.

Called the Precision Flexostop, this device is mounted on the press next to the flywheel. Extra deflection of the flywheel, caused by overload, will trip the Flexostop, which can be adjusted to detect any variation in stock thickness greater than 0.010 in.

By an odd coincidence Precision Welder and Flexopress* salesmen just happen to carry a Flexostop or two in their briefcases. You might ask to see one. It can be installed on most any press with an air clutch in a matter of minutes.

**Flexopress—Its patented ball-bearing ram makes all others obsolete.*

Possibly you missed . . .

These objective articles about other Precision developments:

- ☐ Stock Fed Into Lamination Press at 2500 Inches a Minute, *Machinery*, February, 1958
- ☐ Magnetic-Force Method Welds Vinyl-Laminate Steel Sheet, *Product Engineering*, June 30, 1958

or want more information about these:

- ☐ Peco Butt-Seam Welding Process
- ☐ Precision Flexostop
- ☐ Precision Spot & Projection welders
- ☐ Precision Flexopresses with the Patented Ball-Bearing Ram

Check off what you want and let us know. We'll oblige.

For more data circle this page number on card at back of book

IS YOUR CUTTING TIME *THIS FAST?*

TIME FOR SOME WALLACE "CUT-MACHINING" OPERATIONS

MATERIAL	TIME REQUIRED
1"x1"x⅛" Angle Iron	¼ SEC.
1" Steel Tubing	⅜ SEC.
⅝" Steel Bar	½ SEC.
3"x 16 gauge Stainless Steel Tubing	2½ SEC.
4"x2½"x¼" I-Beam	10 SEC.
4" Iron Pipe	16 SEC.
6"x6"x1" Angle Iron	28 SEC.

Cut Ends can have 30 to 70 micro finish, often eliminating secondary operations.

Wallace 1959 Modular "Cut-Machining" Units are available with gauging assembly, hydraulic or pneumatic clamping devices and with automated controls. With 16", 18", 20" and 26" cutting wheels.

DOES A WALLACE "CUT-MACHINING" UNIT BELONG IN YOUR PLANT?

If You Prefer

Write for 12 Page Catalog containing complete specifications and examples of fast Wallace "Cut-Machining" units.

If your cutting time is more than the examples shown, it will pay you to investigate Wallace. If it is important that the cut ends be so smooth, that secondary operations are unnecessary, then that is another reason why "Cut-Machining" will lower your costs.

Investigate this industry proven machine. Without obligation, our engineers will analyze your work; will make recommendations for your jobs.

Call Factory **BUckingham 1-7000**
CHICAGO
and Reverse Charges PLEASE

WALLACE SUPPLIES MFG. CO.

1310 W. Diversey Parkway • Chicago 14, Illinois
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GEARS

Designed and Manufactured to meet

YOUR

Production Requirements

Custom Gears Exclusively

DIEFENDORF GEAR CORPORATION

Syracuse 1, N. Y.

DIEFENDORF GEARS

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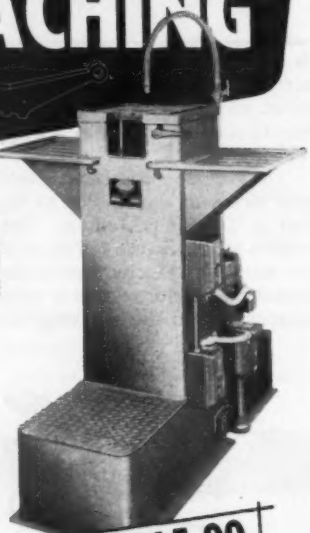
REDUCE MACHINING COSTS *with*

BROACHING



Model VM215-3
INTERNAL & SURFACE BROACHING MACHINE

- 2 Ton - 15" Stroke
- Fully Hydraulic
- Fast Set Up
- Low Cost

Write for Free Literature

PIONEER BROACH COMPANY

6434 Telegraph Road
Los Angeles 22, California

$1565.00
COMPLETE WITH MOTORS & SWITCHES & COOLANT SYSTEM

For more data circle Item 292C on Card

The PULLMAX Cannot be Duplicated or Imitated...

8 SIZES
CAP. UP TO 13/32"

. . . because of its:

- ✻ Unique Patented Features!
- ✻ Strength and Durability!
- ✻ Performance
- ✻ Ease of Operation
- ✻ Quick Tool Change
- ✻ Low Maintenance
- ✻ Capacity

Pullmax machines are sold by a nationwide sales organization, represented in every part of the country by specially trained engineers who analyze, recommend and make demonstrations. Complete engineering facilities are available to solve your special cutting and tooling problems.

Pullmax machines are also backed by a national service organization. Immediate service on all parts is no further away than your phone.

Seeing is Believing: Ask for a Pullmax demonstration unit to visit your plant or send for 16mm sound movie.

Pullmax machines do: straight, circle, inside square, irregular, slot and louver cutting; beading, joggling, edge banding, flanging, dishing and nibbling.

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For more data circle Item 293A on Card

DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

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END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

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IMPROVE FACING OPERATIONS

ON BORING MILLS - DRILLS - LATHES MILLERS AND RADIALS

M-D facing Head feeds automatically. Lathe tool bit travels radially from center outward or reverse. 10 sizes, 6" to 46" dia. Write for bulletin, prices.

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For more data circle Item 293C on Card

WHY CHAMFER prior to tapping?

Why? Because clean, concentric chamfered holes speed tapping operations, increase tap life and accuracy, eliminate breakage, burring or flaking and lower both drilling, tapping and scrap costs.

Therefore, you are time, tools and dollars ahead when you drill and chamfer simultaneously with Mohawk Standard Subland drills.

How? Mohawk "Standards" are faster, more accurate—eliminate jig and fixture movements—increase tool life, reduce scrapped parts and save man hours too! Mohawk Standard Sublands outlast ordinary tools and remain accurate through regrinds—right down to the shank.

Better yet . . . All Mohawk "Standards" are *immediately* available from your local distributor's stock. Call a Mohawk man and start your savings program today!

STANDARD SUBLANDS STOCKED IN ALL PRACTICAL SIZES—3 STEP LENGTHS

Comparison Chart
Drilling and Chamfer methods prior to Tapping

	Standard Mohawk Subland Drill	Step Drill	Separate Operations 2 Drills	Drill Operation Only No Chamfer
Chamfer Concentricity	Excellent	Excellent	Poor	Zero
Hole Location	Excellent	Good	Fair	Fair
Drill Hole Size	Excellent	Poor	Fair	Fair
Pieces Per Grind	Excellent	Fair	Excellent	Excellent
Burrs (None)	Excellent	Good	Fair	Zero
Tap Life	Excellent	Good	Fair	Poor
Regrind	Excellent	Poor	Excellent	Excellent
Local Stock	Excellent	Good	Excellent	Excellent

Remember . . . Mohawk Standard Sublands are on your distributor's shelves—all practical standard sizes, step lengths and shanks.

Ask for Your Copy Today!

This new 12-page catalog that illustrates the multiple advantages of drilling and chamfering (prior to tapping) is yours for the asking. Lists all practical sizes, types and suggests simplified method for determining your requirements.

world's largest producer of Sublands

Mohawk TOOLS, Inc.
Montpelier, Ohio

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CLASSIFIED ADVERTISING RATES: $12 per single column inch

eastern Rebuilt Machine Tools

THE SIGN OF QUALITY

THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—THE LEADER IN THE FIELD OF REBUILT MACHINE TOOLS.

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⅝" Cleveland Model A, m.d., 1943
4 spindle 1¼" Cleveland, Model M, m.d.
4 spindle 2" Model K Cleveland, m.d.
2½" Cleveland, m.d., Model A
3⅝" Cleveland Model A Single Spindle, m.d., late
5½" Cleveland Model A, single spindle, m.d.
5⅝" Cleveland Model A Single Spindle, m.d., late
No. 4D Potter & Johnston, m.d., late
No. 5D2 12" Potter & Johnston, m.d.
No. 5DELX Potter & Johnston, m.d., late

BOLT THREADERS
Victor Nut Facing Machine, m.d., cap. ⅜" to 2" nuts
1¼" Landis 2 spindle, m.d.
1½" Landis Bolt Threading Machine, double head stay bolt, m.d.

BOREMATICS
No. 44 Heald Facing Type Borematic, m.d.
Model DB-102 Excello Double End Boring Machine, m.d.
No. 49 Heald Double End Borematic, m.d.

HORIZONTAL BORING MILLS
4" bar, No. 42 Lucas, table type
No. 25T Giddings & Lewis, m.d.
No. 32 Lucas Table type, m.d.
No. 41 Lucas Horizontal Table Type, m.d.
No. 1 Cleveland Horizontal Boring, Drilling & Milling, m.d.
2½" bar Model 25RT Giddings & Lewis, table type
3⅛" bar Cincinnati Gilbert Horizontal, Boring, Drilling & Milling, floor type
4" bar Universal Horizontal Table Type, m.d.
4¼" bar, Model 72, Niles-Bement-Pond, m.d.
5½" bar Niles-Bement-Pond, m.d.
6" bar Sellers Floor Type, m.d.
Barrett Double End, 5" and 7" spindle, m.d.

VERTICAL BORING MILLS
16" Bullard Mult-Au-Matic, m.d.
24" Bullard Spiral Drive, m.d., 1944
36" Bullard, m.d., Late 1944, Spiral Drive
40" Froriep Model KE-10-8, m.d.
42" King, m.d.
44" Putnam, m.d., p.r.t.
52" Niles Heavy Pattern, m.d., p.r.t.
60" Bullard, m.d.

BROACHING MACHINES
12x72" Thompson Automatic Flat Broach, m.d.
10 ton, 84" stroke LaPointe Single Ram Vertical Surface Broach, m.d., late
Type SBD-42-6 American Vertical Hy. Dup. Broach
Type SBD-48-15 American Vertical Dup. Ram Surface Hydraulic Broach

RADIAL DRILLS
2'-9" col. Fosdick Plain, m.d.
3'-9" col. Cincinnati-Bickford, m.d.
3'-11" col. Morris Mor Speed Plain, m.d. on arm
4'-11" col. Canedy-Otto-Cincinnati, m.d.
4'-13" col. Fosdick, 1944
6'-17" col. American Triple Purpose, m.d.
7'-16" col. American Triple Purpose, m.d.
8'-17" col. Dreses, gear box m.d.
Baush Radial Drilling & Tapping Machine, m.d.

BALL BEARING DRILLS
No. ⅛ Avey MA8, m.d.
No. 2 Avey, m.d.
No. 2LM8 Leland & Gifford, m.d., H.S.
No. 2LMS Leland & Gifford, single spindle, H.S., m.d.
No. 4BM Fosdick, single spindle H.S., m.d.
No. 4MS Leland & Gifford H.S., 4 speed A.C., m.d. to spindle
1 spindle No. 2MA6 Avey H.S. Type B, m.d., 7½" overhang, 1943
2 spindle Atlas Bench Type, 1942
2 spindle Allen, belted m.d., 8" overhang
2 spindle No. 2 Avey H.S., belted m.d.
2 spindle No. 2RMA, No. 1 Avey Production Type, m.d.
2 spindle No. 2MS Allen, H.S., m.d.
2 spindle No. 2 Leland & Gifford H.S., 8" overhang, m.d.
2 spindle Leland & Gifford H.S. Hydraulic Type, m.d.
2 spindle No. 2LMS Leland & Gifford, hydraulic step by step H.S., m.d.
3 spindle No. 3 Morse Taper, Foote-Burt "Sipp" H.S., m.d.
3 spindle No. 2B-8" Edlund, m.d., H.S.
3 spindle No. 2MA6 Avey, H.S., m.d.
3 spindle Leland-Gifford ⅔1LMS—H.S., m.d., late
3 spindle Leland-Gifford H.S., m.d.
4 spindle Leland-Gifford, m.d. on each spindle
4 spindle No. 15 Buffalo Bench Type
4 spindle Allen H.S. belt drive
4 spindle No. ½ MA8 Avey, m.d., H.D.
4 spindle Domeo H.S., individual m.d.
4 spindle No. 2MS Edlund, m.d.
4 spindle No. 2MS Edlund, m.d.
5 spindle Allen H.S., belt drive
6 spindle Allen H.S., 7" overhang
6 spindle Leland-Gifford m.d., on each spindle No. 2 taper
6 spindle No. 1 Avey High Speed, m.d.
6 spindle No. ½ Avey MA8, H.S., m.d.

HORIZONTAL DRILLS
2 spindle No. 410 W. F. & John Barnes, m.d.
No. 410 W. F. & John Barnes, Horizontal Boring & Drilling Machine, m.d.
No. 410 Barnes Single Spindle Deep Hole m.d.
No. 2 Avey Stype MA1, with horizontal operation
No. ⅛Bx50" Pratt & Whitney Gun Barrel Rifling, Model M1821, m.d., latest
No. 1⅛"x105" Pratt & Whitney, 2 spindle Hydraulic Deep Hole Drill, Model 973, m.d., latest
No. 1⅛"x105" Pratt & Whitney, Model M1825, 2 spindle Gun Barrel Rifling, m.d.
No. 1 Model M509 Pratt & Whitney 2 spindle Deep Hole Drill, belted m.d.
¾"x40" Bausch Double Horizontal Drilling Machine, m.d.
No. 445 W. F. & John Barnes Independent 2 spindle Deep Hole Drill & Boring Machine, late
No. 2F1 Natco Horizontal Boring & Drilling Machine
Natco, Holesteel Model, m.d.
Natco Horizontal Drill, 2 opposed B4F2 Head, 1943
No. 2 Le Blond Deep Hole Borer, 1943

MULTIPLE SPINDLE DRILLS
2 spindle No. 201¼ Barnes, m.d., H.D.
2 spindle No. 6 Colburn Manufacturing Type H.D., separate m.d. to ea. spindle
3 spindle 28" Cincinnati-Bickford Upright Drill, m.d., No. 4 M.T.
4 spindle No. 201¼ Barnes H.D., m.d.
6 spindle Model M1613 Pratt & Whitney In Line Vertical Drill

The above is only a partial listing
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RE-BUILDING
at its Best

Miles' re-building adds extra life to machine tools. For example, notice the nitrided steel wearing plates installed on this header slide from a 3" National upsetter.

Auto 1½" 8 spindle Consomatic
Alto 2" 4 spindle Model 2K4 Cleveland
Auto 5" 4 spindle Consomatic
Balancer 30" GM Research Model STA170, new
Borer No. 2U Simplex double end Stoker unit, late
Borer Model DB1212 and DB1212A Excello double end (2)
Broach 10 ton 66" stroke, Type XL-20-66 Oilgear double slide vertical hydraulic surface
Drills, Horiz. Natco Holeunit 2 way hydraulic
Drills, Mult. 36 spindle No. 4BL Natco, late, 15 HP
Drills, Mult. Model B2A Natco "hole steel" hydraulic, 3 heads
Drills, Radial 5' 14" Cincinnati Bickford
Drills, Sensitive 24" swing No. 3 Allen 3 spindle PF, 15 HP MD
Drills, Sensitive 4 spindle Leland Gifford motor on spindle, hydraulic
Drills, Upright 21" Cincinnati Bickford super servce, Model 1L, all geared, TA late
Engraver Model BL 2416 Pratt & Whitney 3 spindle MD
Gear Machinery No. 7A Model 7125A Fellows high speed universal gear shaper
Gear Machinery 12" Gleason straight bevel gear generator, new 1949.
Gear Machinery No. 13 Gleason universal gear tester for straight and spiral bevels
Gear Machinery 8" Red Ring hydraulic gear lapper, late, MD
Grinders, Centerless No. 12 Landis, new 1948
Grinders, Centerless No. 2 Cincinnati centerless, Filmatic, for bolt and nut work, late.
Grinders, Cylindrical 4" x 12" Model H hydraulic
Grinders, Cylindrical 10" x 36" Landis type DC Plain hydraulic
Grinders, Cylindrical 14" x 36" Landis type C plain hydraulic
Grinders, Internal No. 72A3 Heald Sizematic, swivel headstock
Grinders, Internal No. 72A5 Heald hydraulic extended bridge
Grinders, Internal No. 72A5 Heald universal cross sliding headstock T base, late
Grinders, Surface 6" x 18" No. 2 Brown & Sharpe (2) late
Grinders, Surface 8" x 24" No. H3 Abrasive, motor on spindle
Grinders, Surface 12" x 12" x 48" Thompson type C horizontal spindle hydraulic

OVER 1,000 NEW AND USED MACHINE TOOLS IN STOCK
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MILES MACHINERY COMPANY
2045 EAST GENESEE • SAGINAW, MICH. PL. 2-3105

METALWORKING PLANT SUPERINTENDENT WANTED

- Top-notch position for high-grade, experienced man; salary open.
- Qualifications: mechanical engineer; age 35-40; sound background in forging, machine shop, finishing, heat-treating, methods, etc.
- Supervise plant of about 200 men; factory and home office in Owatonna.
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All replies confidential.

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OWATONNA, MINNESOTA

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Foreman for machine shop of Pittsburgh, Pa. area manufacturer, man over 30, versed in Warner and Swasey chucking and bar production, tooling, estimating, work organization and handling men. Man preferred who has had experience operating turret lathes. Secondary facilities include milling machines, engine lathes, fox lathes, drill presses, etc. Applicants will be tested to assure qualifications. Write giving address and phone to **Box 727, Machinery, 93 Worth St., New York 13, N.Y.**

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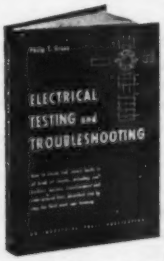
No. 2, 4, 5, 1A, 2A Warner & Swasey Preselector Turret Lathes, abr Feed, Chucking. Swasey Preselector Turret Lathes, Bar Feed, Chucking.
2A BROWN & SHARPE, Hi- Speed Univ. Mill, 1945.
14" x 16" x 60", 24" x 24" x 96".
MATTISON Hyd. Horiz. Surface grinder.
Type 24" Cin. Bickford Super Service Drill Press.
9A Marvel Hack Saw 10" x 10" cap.
1, 3, 6, Sp. 2LMS-26" Leland Gifford Drill Press.
FALK-MACHINERY CO.
19 Ward Street — BA 5-5887 — Rochester, N.Y.

TESTED ELECTRICAL PROCEDURES DESCRIBED BY AN EXPERT



ELECTRICAL TESTING AND TROUBLESHOOTING, by Philip T. Green explains tested procedures clearly and completely.

This book will show you how to locate and correct faults in circuits of all kinds, including—controllers, motors, transformers and transmission lines. A briefing on electrical symbols and diagrams is followed by detailed discussions on: Analyzing and charting controller operation, Insulation testing, Electromagnet winding, Single-Phase transformers, Polyphase transformers, Synchronous motors, Troubleshooting test equipment, Locating grounds, D.C. machine windings, Phase sequence, Induction motors, Power cable faults, Bearing lubrication.

The tests are performed with the equipment isolated from the power line. Current is supplied by dry cells or residual magnetism so that accidental contact and short circuits are less hazardous. All of the trouble shooting procedures described here have been tested and proven to be great time-savers—especially for locating obscure source of trouble.

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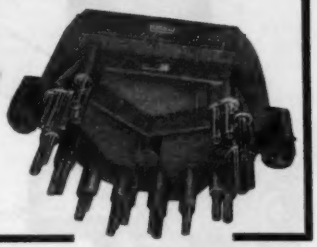
Fixed Center

DRILLHEAD

does 27 jobs in 1 fast operation!



Get maximum production—use Thriftmaster designed and built Fixed Center Drillheads . . .

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- All types, including angular, rotating and lead screw
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- Guaranteed performance backed by over 25 years of engineering and production experience

Also Full Ball Bearing Universal Joint, Single and Double Eccentric Adjustable Drillheads and Dorman Tappers.

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Pennsylvania

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SERIES "AL" TUMICO DIAL INDICATORS

These exceptionally accurate gages have the unique distinction of having a 1" or 2" travel. Simple design and rugged construction assure outstanding accuracy & long life.

Shown - Model AL-13
Reading .001" - Grad. 0-100
Dia. 3" - Travel 2" **$40.80**

READING IN .001" or .0005"

Stainless steel stem and spindle. Choice of 6 graduations with either balanced or continuous dial. Unbreakable crystal. Adjustable bezel with clamp for locating zero. Two dial diameters available - 2¼" & 3" for 1" travel and 3" for 2" travel gages. Jewelled bearings available on all models.

For Complete Information request our 96 Page Catalog Contact any of our 6 "Coast to Coast" Locations or your nearest Local Distributor.

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CHICAGO: 5045 W. Harrison, Chicago 44, Ill.
When writing to any of the above locations, refer to DEPT D-2

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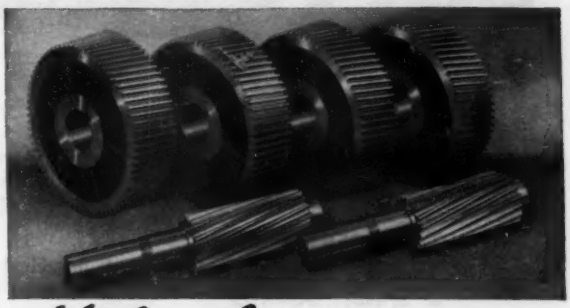

Helical GEARS AND PINIONS

SPURS TO 72" PD, 1 DP
BEVELS TO 54" PD, 1 DP
SPIRAL, HELICAL and WORM GEARS TO 48" PD, 2 DP
CONTINUOUS TOOTH HERRINGBONE TO 60" PD, 2 DP
SPROCKETS TO 72" PD, 2½ CP
RACKS TO 20 FT. LONG, 3 DP
SILENT GEARS: RAWHIDE, BAKELITE, FIBROIL
HEAT TREATED, CASE OR FLAME HARDENED GEARS— OF CARBON OR ALLOY STEEL

Ready for long, trouble-free use in bar straightening equipment, these precise examples of Stahl's craftsmanship in gear fabrication have been double-checked for strict compliance with specifications. Illustrated are 4 steel helical gears—24.697" F., 72 T., 3 D.P., together with 2 Hyten B3X steel shaft pinions 6.758" O.D., 16¾" F., 35" Length-over-all. Heat treated. Let Stahl end your gear worries—send for our estimate.

Stahl
GEAR & MACHINE COMPANY
3901 HAMILTON AVENUE
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For more data circle Item 295E on Card

GEARS—ALL MAKES . . . Special and standard

PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy Quality and Fine Workmanship

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CAMS

ALL TYPES MADE TO YOUR SPECS!

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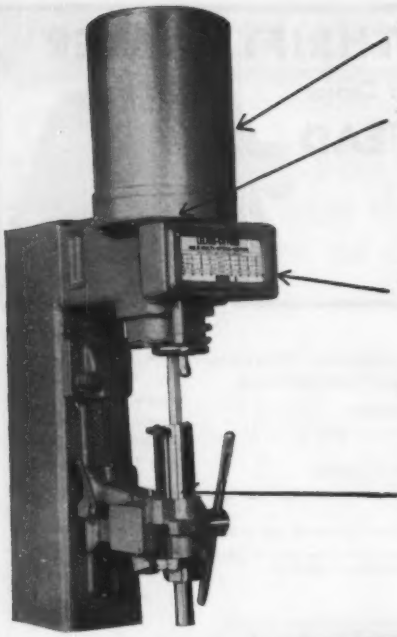


1. TOTALLY ENCLOSED MOTOR

Windings and air gap completely protected from dust, dirt, chips.

2. DIRECT DRIVE

Direct drive from four-speed motor to spindle for smooth power transmission. For extreme speed range, can be furnished with back gears. Speeds from 90 RPM up to 3600 with torque multiplication up to six times supplies brute power for large drills, ample speed for drills down to 1/16".

3. INDICATING SHIFT

For positive speed indication. Tells right speed to use for drill sizes in three different SFM ranges. Convenient hand wheel shifts speed without stopping machine.

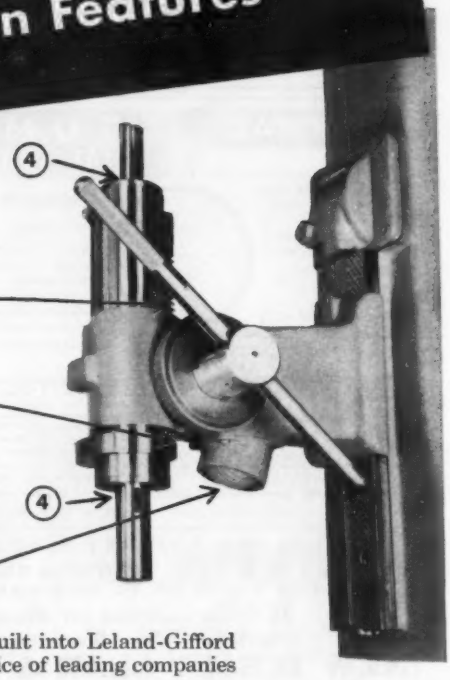
4. OIL MIST LUBRICATION

Radial-thrust ball bearings are constantly and properly lubricated at all speeds by oil mist. Spindle splines lubricated by felt wipers.

5. OVERSIZE SPINDLE QUILL

Oversize quills are 2 3/16" in diameter. Large bearing area maintains accuracy and assures long life.

Only LELAND-GIFFORD Drilling Machines have all these Precision Features



6. INSERTED STEEL RACK

Inserted steel rack prevents radial motion which can cause uneven tooth loads on feed pinion. Also insures accurate alignment when multiple heads are used.

7. BROACHED SLOT

Rack slides in slot precision broached into head.

8. SPINDLE GUARDS

Telescopic guard can be furnished to completely cover the spindle, protect operator from fast-moving multiple splines.

9. BUILT-IN LIGHT

Built into sliding head. Puts the light on the work where it ought to be. Never in the way like makeshift lighting.

Compare the quality, workmanship and precision features built into Leland-Gifford Drilling Machines and you will see why they are the first choice of leading companies for toolroom and production lines.

LELAND-GIFFORD

Drilling Machines

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P. O. Box 24, Charlotte Station

Alphabetical Index of Advertisers

A

Allegheny Ludlum Steel Corp. 80
Allen-Bradley Co. ..... Insert 183-184
Allen Manufacturing Co. 262
American Brass Co. 69
American Pullmax Co., Inc. 293
American Schiess Corp. 87
American Society of Tool Engineers 244-245
American Steel Foundries 197
American Tool Works Co. 53
American Waldrich Mfg. Corp. 86
Ames, B. C., Co. 54
Armstrong-Blum Mfg. Co. 50
Armstrong Bros. Tool Co. 78
Atlas Press Co., Clausing Div. 56
Austin Industrial Corp 274
Avondale Marine Ways, Inc. 240

B

Baker Bros., Inc. 34
Baldwin-Lima-Hamilton Corp. 255
Barber-Colman Co. ..... Insert 58-59
Bardons & Oliver, Inc. 89
Barnes Drill Co. 201
Barnes, W. F. & John Co. 66
Beatty Machine & Mfg. Co., Beatty-Quickwork Div. 266
Beatty-Quickwork Div., Beatty Machine & Mfg. Co. 266
Beckett-Harcum Co. 234
Bethlehem Steel Co. 207, 249
Birdsboro Corp. 24
Blanchard Machine Co. 257
Bliss, E. W., Co. ..... Front Cover
Boston Gear Works 77
Bridgeport Machines, Inc. 32
Brook Motor Corp. 270
Brown & Sharpe Mfg Co. 71-76
Buck Tool Co. 268
Buckeye Tools Corp. 236
Buffalo Forge Co. 95
Bullard Co. 289
Burg Tool Manufacturing Co., Inc. 28-29

C

Carlton Machine Tool Co. 223
Carroll-Jamieson Machine Tool Co. .. 280
Chicago Heights Steel Co., Spedicut Div. 221
Chicago-Latrobe 92
Cincinnati Gear Co. 238
Cincinnati Lathe & Tool Co. 195
Cincinnati Milling Machine Co. 6-7
Cincinnati Milling Machine Co., Meta-Dynamics Div. 209
Cincinnati Milling Products Div., Cincinnati Milling Machine Co. .. 33, 39
Cincinnati Shaper Co. 22-23
Clark Instrument, Inc. 242
Classified Advts. 294
Clausing Div., Atlas Press Co. 56
Clearing Div., U. S. Indus. Inc. Back Cover
Cleco Air Tools Div., Reed Roller Bit Co. 239
Cleveland Automatic Machine Co. ... 205
Cleveland Crane & Engrg. Co. 269
Cleveland Punch & Shear Works Co. 277
Cleveland Worm & Gear Co. 98
Columbia Tool Steel Co. 286
Columbus Die-Tool & Mch. Co. 252
Cogsdill Twist Drill Co., Inc. Inside Back Cover
Continental Tool Wks. Div., Ex-Cell-O Corp. 189
Cross Company 16-17
Crucible Steel Co. of America 18-19
Cushman Chuck Co. 227

D

Danly Machine Specialties, Inc. 267
Davis & Thompson Co. 276
Delta Power Tool Div., Rockwell Mfg. Co. 265
Denison Engineering Div., American Brake Shoe Co. 215
De Vlieg Mch. Co. 44-45
DoAll Co. 48
Diefendorf Gear Corp. 292
Dykem Co. 293

E

Eastern Machinery Co. 294
Eastman Kodak Co. 237
Edlund Machinery Co. 229
Eisler Engineering Co., Inc. 295
Ex-Cell-O Corp. 51, 55, 189

F

Fafnir Bearing Co. 198
Falk Machinery Co. 294
Famco Machine Co. ..... Insert 219
Federal Products Corp. 30-31
Fellows Gear Shaper Co. 4-5
Fiske Bros. Refining Co., Lubriplate Div. 290
Futurmill, Inc. 250

G

Gardner Machine Co. 25, 43
Giddings & Lewis Machine Tool Co. 216-217
Gisholt Machine Co. .... Insert bet. 32-33
Gleason Works 79
Goss & DeLeeuw Mch. Co. 232
Gray, G. A. Co. 20-21
Greaves Machine Tool Co. 256
Greenlee Bros. & Co. ..... Insert 65
Grieder Industries, Inc. 284

H

Hanchett-Magna-Lock Corp. 278
Hardinge Brothers, Inc. 90-100
Heald Machine Co., The Inside Front Cover
Hill Acme Co. 46
Hydraulic Press Mfg. Co. 85

I

Induction Heating Corp. 299

J

Jacobs Manufacturing Co. 271

K

Kearney & Trecker Corp. 243
Kennametal, Inc. 281
King Machine Tool Div., American Steel Foundries 197
Kingsbury Machine Tool Corp. 38

L

L & J Press Corp. 282
Lake Erie Machinery Corp. 26-27
Laminated Shim Co., Inc., Stampings Div. 41
Landis Machine Co. 2-3
Landis Tool Co. 8-9
LeBlond, R. K., Machine Tool Corp. 224-225
Leland-Gifford Co. 296
Logan Engineering Co. 222
Lubriplate Div., Fiske Bros. Refining Co. 290
Lucas Machine Div., New Britain Machine Co., The ..... Insert bet. 48-49

M

Madison-Kipp Corp. 270
Marac Machinery Corp. 42
Marlin-Rockwell Corp. 251
Mattison Machine Works ..... Insert 64
Metallurgical Products Dept., General Electric Co. 52
Micromatic Hone Corp. 260-261
Miles Machinery Co. 294
Minster Machine Co. 241
Mitts & Merrill 288
Modern Machine Tool Co. 250
Mohawk Tools, Inc. 293
Monarch Machine Tool Co. 231
Moore Special Tool Co., Inc. 68
Mummert-Dixon Co. 293

N

National Broach & Machine Co. 82
National Twist Drill Co. 37
New Britain Machine Co., The New Lucas Machine Div. ... Insert bet. 48-49
New Britain Machine Co., The New Britain-Gridley Machine Div. 93-94
New Jersey Gear & Mfg. Co. 295
Niagara Mch. & Tl. Wks. 91
Norton Company, Gould & Eberhardt Div. 14-15

O

Oliver Instrument Co. 97
Olivetti Corp. of America 263
Onsrud Machine Works, Inc. 246
Opto-Metric Tools, Inc. 286

P

Pangborn Corporation 300
Pannier Corp. 228
Pioneer Broach Co. 292
Pratt & Whitney Co., Inc. (Potter & Johnson Machines 212-214
Precision Welder & Flexopress Corp. 291

R

Reed Rolled Thread Die Co. 258
Reeves Pulley Co. Div. Reliance Electric & Engrg. Co. 49
Reliance Electric & Engrg .Co. 49
Revere Copper & Brass, Inc 191
Rockford Machine Tool Co. .. Insert 62-63
Rockwell Mfg. Co., Delta Power Tool Div. 265
Rowe Machinery & Manufacturing Co., Inc. 298
Russell, Burdsall & Wald Bolt & Nut Co. 203
Ruthman Machinery Co. 230
Ryerson, Joseph T. & Son, Inc. 102

S

SKF Industries, Inc. 247
Safety Socket Screw Co. 226
Scherr-Tumico Co. 295
Schrader's A, Son, Div. Scovill Mfg. Co., Inc. 88
Sheldon Machine Co., Inc. 248
Shore Instrument & Mfg. Co., Inc. ... 264
Slocomb Co., J. T. 254
Snyder Corp. 193
Springfield Machine Tool Co. 233
Stahl Gear & Machine Co. 295
Standard Electrical Tool Co. 285
Standard Oil Co. (Indiana) 47
Standard Tool Co. 259
Stuart, D. A., Oil Co., Ltd. .. Insert 83-84
Sundstrand Machine Tool Co. Div. Sundstrand Corp. .... Insert 60-61

T

Textile Machine Works 287
Thomson Industries, Inc. 187
Thriftmaster Products Corp. 295
Timken Roller Bearing Co. 40
Tomkins-Johnson Co. 253
Ty-Sa-Man Machine Co., Inc. 275

U

U. S. Industries, Inc., Clearing Div. ..... Back Cover
U. S. Tool Company, Inc. 10-11
Universal Engineering Co. 96

V

Van Norman Machine Co. 272-273
Verson Allsteel Press Co. 279
Vickers, Inc. 81

W

Waldes Kohinoor, Inc. 67
Wales Strippit, Inc. 70
Walker, O. S. Co., Inc. 283
Wallace Supplies Mfg. Co. 292
Warner & Swasey Co. 12-13
Wichita Clutch Co. 35
Wickes Machine Tool Div., Wickes Corp. 235
Winter Bros. 36

Y

Yoder Co. 220

information guide

Want more information? Below are listed the products advertised in this issue. Page numbers after advertisers names refer to location of ad and number to be circled on cards for more data.

This guide is compiled as a convenience to our readers. Every care is taken to keep it accurate. Machinery assumes no responsibility for errors or omissions.

AIR TOOLS, PORTABLE
Cleco div. Reed Roller Bit Co. 239

BAND SAWING MACHINES
Armstrong Blum Mfg. Co. ... 50
Delta Power Tool 265
DoALL Co. 48

BAR MACHINES, AUTOMATIC
Brown & Sharpe Mfg. Co. 76
Cleveland Automatic Mch. Co. 205

BEARINGS
Fafnir Bearing Co. 198
Marlin-Rockwell Corp. 251
SKF Industries 247

BORING BARS
Kennametal, Inc. 281

BORING MACHINES
Ex-Cell-O Corp. 51
New Britain Mch. Co. 93

BORING MILLS
American Schiess Corp. 87
Carlton Mch. Tool Co. 223
DeVlieg Machine Co. 44-45
Gray, G. A. Co. 20-21
Hamilton div., Baldwin-Lima-Hamilton 255
Heald Machine Co. Inside Front Cover
King Machine Tool Div. 197

BRASS
Revere Copper & Brass, Inc. . 191

BROACHING MACHINES
Pioneer Broach Co. 292C

BUSHINGS
Ex-Cell-O Corp. 55

CAMS
Eisler Engineering Co. 295C

CHUCKING MACHINES, AUTOMATIC
Goss & DeLeeuw Machine Co. 232

CHUCKS
Buck Tool Co. 268
Cushman Chuck Co. 227
Hanchett Magna-Lock Corp. . 278
Jacobs Mfg. Co. 271
Universal Engineering Co. .. 96
Walker, O. S. Co., Inc. 283

CLEANERS, METAL
Pangborn Corp. 300

CLUTCHES
Wichita Clutch Co. 35

COIL CRADLES
Rowe Machinery & Mfg. Co. .. 298

COLLETS
Hardinge Brothers, Inc. 90

COMPARATORS, OPTICAL
Eastman Kodak Co. 237
Opto-Metric Tools 286A

CONTRACT WORK
Textile Machine Works 287

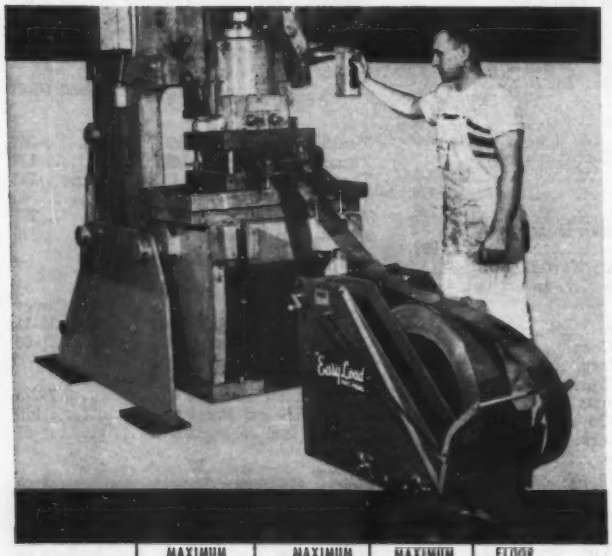
COPPER
American Brass Co. 69

CUTTING & GRINDING FLUIDS
Cincinnati Milling Products Div. 33
Standard Oil Co. (Indiana) .. 47
Stuart, D. A. Oil Co. 83

CUTTING OFF MACHINES
Delta Power Tool 265
Grieder Industries, Inc. 284
Modern Mch. Tool Co. 250B

get HEAVY DUTY performance with

ROWE 2000 SERIES "Easy Load" COIL CRADLES



MODEL	MAXIMUM WEIGHT CAPACITY	MAXIMUM WIDTH CAPACITY	MAXIMUM O.D. CAPACITY	FLOOR SPACE REQUIRED
2010	2000#	10"	40"	16" x 32"
2015	2000#	15"	40"	21" x 32"
2020	2000#	20"	40"	26" x 32"
2024	2000#	24"	40"	30" x 32"

Engineered and built to exacting specifications, ROWE 2000 Series "Easy Load" Cradles will perform perfectly under the most rugged operating conditions. The 5/16-inch thick steel frame will take a tremendous beating. The precision machined and threaded guide bars are alloy tough and heavy duty bearings support the feed rolls under repeated coil contact. The dependable chain drive with flame hardened sprockets feeds most materials accurately and without slipping.

Cradles in the 2000 Series can reduce your set up time because they can be moved easily and all models are equipped with two movable side guides which quickly position the coil for feeding. Four sturdy, fully-powered rolls feed coils weighing up to 2,000 pounds with positive, direct control. An easily adjustable, built-in time delay allows the press ram to clear before the next coil segment is fed — eliminating crimping and buckling. The actuator arm maintains a constant size slack loop, following the contour of any coil and operating in any position.

Investigate the complete ROWE line soon. Other equipment includes "Easy Load" Coil Cradles to 20,000 pound capacity, Straightening Machines, Straightening and Feeding Machines, Cabinet Feeds, Roll Feeds, Coil Catchers and Storage Ramps, Combination Cradle and Straightening Machine Units, Coil Buggies, Reels, Conveyors, Stackers and Complete Sheeting Lines.

Affiliate AGTI Member — Associate PMA Member

ROWE MACHINERY AND MANUFACTURING CO. INC.
811 REGAL ROW DALLAS, TEXAS

information guide

CUTTING TOOLS
Chicago Heights Steel Co. ... 221
Chicago-Latrobe 92
Cogsdill Twist Drill Co. Inside Back Cover
Ex-Cell-O Corp. 189
Mohawk Tools, Inc. 293D
National Twist-Winter Bros. 36-37
Pratt & Whitney Co. 214
Standard Tool Co. 259

CYLINDERS
Schrader's, A. Son 88
Tomkins-Johnson Co. 253
Vickers, Inc. 81

DRILL HEADS
Thriftmaster Products Corp. 295D

DRILLING MACHINES
Baker Brothers, Inc. 34
Brown & Sharpe Mfg. Co. 75
Buffalo Forge Co. 95
Burg Tool Mfg. Co., Inc. 28-29
Carlton Mch. Tool Co. 223
Delta Power Tool 265
Edlund Machinery Co. 229
Leland-Gifford Co. 296

DRILL SHARPENERS
Cincinnati Lathe and Tool Co. 195

DRILLS, PORTABLE
Buckeye Tools Corp. 236

DUPLICATING MACHINES
Bridgeport Machines, Inc. ... 32

FACING HEADS
Mummert-Dixon Co. 293C

FASTENERS
Allen Manufacturing Co. 262
Russell, Burdsall & Ward Bolt & Nut Co. 203
Safety Socket Screw Co. 226

GAGING & MEASURING EQUIPMENT
Ames, B. C. Co. 54
Brown & Sharpe Mfg. Co. 72
Federal Products Corp. 30-31
Scherr Tumico 295A

GEAR CHECKING EQUIPMENT
Gleason Works 79

GEAR CUTTERS
Barber-Colman Co. 58-59
Fellows Gear Shaper 4-5
National Broach & Machine Co. 82
Norton Co. 14-15

GEARS
Avondale Marine Ways, Inc. . 240
Cincinnati Gear Co. 238
Diefendorf Gear Corp. 292B
New Jersey Gear Co. 295B
Stahl Gear Co. 295E

GRINDING MACHINES
Blanchard Machine Co. 257
Brown & Sharpe Mfg. Co. 74
Delta Power Tool 265
Gardner Mch. Co. (Disc) 25
Hill Acme Co. 46
Landis Tool Co. 8-9
Mattison Mch. Works 64
Oliver Instrument Co. 97
Olivetti Corp. of America ... 263
Van Norman Mch. Co. 272-273

GRINDING WHEELS
Cincinnati Milling Products Div. 39
Gardner Machine Co. 43

HARDNESS TESTERS
Clark Instrument, Inc. 242
Shore Instrument & Mfg. Co., Inc. 264

HONING EQUIPMENT
Barnes Drill Co. 201
Micromatic Hone Corp. ... 260-261

HYDRAULIC FEEDS
Beckett-Harcum Co. 234

INDUCTION HEATING EQUIPMENT
Induction Heating Corp. 299

JIG BORERS & GRINDERS
Austin Industrial Corp. 274
Moore Special Tool Co., Inc. . 68

JIGS & FIXTURES
Columbus Die-Tool & Mch. Co. 252

KEYSEATERS
Mitts & Merrill 288

LATHES
American Tool Works Co. 53
Bardons & Oliver, Inc. 89
Bullard Co. 289
Carroll-Jamieson Mch. Tool .. 280
Cincinnati Milling Mch. Co., Meta Dynamics Div. 209
Clausing Div., Atlas Press Co. 56
Clearing Div. ..... Back Cover
Delta Power Tool 265
LeBlond Mch. Tool Co. ... 224-225
Logan Engineering Co. 222
Monarch Mch. Tool Co. 231
New Britain Mch. Co. 94
Pratt & Whitney Co. 212-213
Sheldon Machine Co., Inc. ... 248
Springfield Mch. Tool Co. 233
Warner & Swasey Co. 12-13
Wickes Mch. Tool div. 235

LAYOUT FLUID
Dykem Co. 293B

LUBRICANTS
Lubriplate Div., Fiske Bros. Ref. Co. 290
Stuart, D. A. Oil Co. 84

LUBRICATING SYSTEMS
Madison-Kipp Corp. 270A

MARKING DEVICES
Pannier Corp. 228

MICROMETERS
J. T. Slocomb Co. 254

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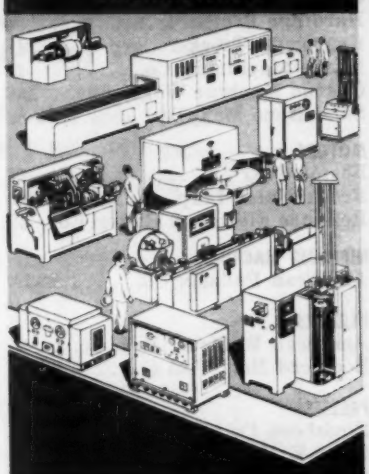

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MOTOR GENERATOR

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- THER-MONIC offers to industry *the most complete line* of induction heating equipment.

Contact our factory or your local IHC representative.

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INDUCTION HEATING CORP.
181 WYTHE AVE., BROOKLYN 11, N.Y.

information guide

MILLING MACHINES
Cincinnati Milling Mch. Co. . 6-7
Famco Machine Co. 219
Greaves Machine Tool Co. ... 256
Hardinge Brothers, Inc. 100
Kearney & Trecker Corp. 243
Marac Machinery Co. 42
Onsrud Machine Works, Inc. . 246
Sundstrand Mch. Tool 60-61

MOTORS
Boston Gear 77
Brook Motor Corp. 270B
Reliance Electric & Engrg. Co. 49

NIBBLING MACHINES
American Pullmax Co. 293A

PLANERS
American Waldrich Mfg. Co. . 86
Rockford Mch. Tool Co. 62-63

PRESSES
Birdsboro Corp. 24
Bliss, E. W. Co. ..... Front Cover
Cleveland Punch & Shear ... 277
Danly Mch. Specialties 267
Denison Engineering Div. 215
Hydraulic Press Mfg. Co. 85
L & J Press Corp. 282
Lake Erie Machinery Corp. . 26-27
Minster Mch. Co. 241
Niagara Machine & Tool Works 91
U. S. Tool Company, Inc. ... 10-11
Verson Allsteel Press Co. 279
Wales Strippit, Inc. 70

PRESS BRAKES & SHEARS
Cincinnati Shaper Co. 22-23
Cleveland Crane & Engrg. ... 269

PUMPS
Brown & Sharpe 73
Ruthman Machinery Co. 230

RETAINING RINGS
Waldes Kohinoor, Inc. 67

SAWING MACHINES
Ty-Sa-Man Mch. Co. 275
Wallace Supplies Mfg. Co. .. 292A

SHAFTS
Thomson Industries, Inc. 187

SHEARS
Beatty Machine & Mfg. Co. .. 266

SLIDES & TABLES, MACHINE
Standard Electrical Tool Co. . 285

SLITTERS, ROTARY
Yoder Co. 220

SPEED REDUCERS
Cleveland Worm & Gear Co. .. 98

STAMPINGS
Laminated Shim Co. 41

STEEL
Timken Roller Bearing Co. ... 40
Ryerson Steel 102

STEEL, TOOL
Allegheny Ludlum Steel Corp. 80
Crucible Steel Co. 18-19

THREADING EQUIPMENT
Landis Mch. Co. 2-3
Reed Rolled Thread Die Co. .. 258

TOOL HOLDERS
Armstrong Bros. Tool Co. 78
Metallurgical Products Dept. . 52
Universal Engineering Co. ... 96

TRANSFER MACHINES, MULTI-UNIT
Barnes, W. F. & John Co. 66
Cross Co. 16-17
Davis & Thompson Co. 276
Greenlee Bros. & Co. 65
Kingsbury Mch. Tool Corp. .. 38
Snyder Corp. 193

VALVES
Brown & Sharpe Mfg. Co. ... 73
Schrader, A. Son 88
Vickers, Inc. 81

WAY COVERS
Futurmill, Inc. 250A

WELDING EQUIPMENT
Precision Welder & Flexopress 291

To cut your blast cleaning costs . . .

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CLEANS IT FAST WITH
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MACHINES AND ABRASIVE

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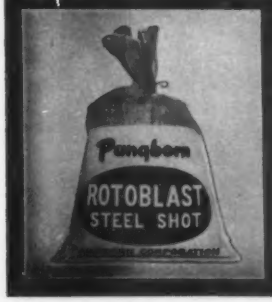

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information center

Find sources for more data, quickly, easily. Use MACHINERY'S Information guide on preceding pages. Advertisers in this issue are listed alphabetically by product. Page numbers following company names indicate both location of ad and number to be circled on cards for more data.

Use Postcards Below For . . .

- **More information on products advertised**
- **More data on new equipment described**
- **Copies of catalogs and bulletins offered**

1. Circle page numbers of advertisements—if no page number appears on ad refer to advertisers' index or information guide.
2. Circle item numbers of new equipment, catalog descriptions.
3. Mail . . . we'll do the rest.

For Advertisements—Circle Page Numbers

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	187	189	191	193	195
197	198	201	203	205	207	209	212	213	214	215	216
217	219	220	221	222	223	224	225	226	227	228	229
230	231	232	233	234	235	236	237	238	239	240	241
242	243	244	245	246	247	248	249	250A	250B	251	252
253	254	255	256	257	258	259	260	261	262	263	264
265	266	267	268	269	270A	270B	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286A	286B
287	288	289	290A	290B	291	292A	292B	292C	293A	293B	293C
293D	294	295A	295B	295C	295D	295E	295F	296	298	299	300
701	702	703	704	705	706	707					

COVERS: FRONT — INSIDE FRONT — INSIDE BACK — BACK

For New Equipment, Catalogues—Circle Item Numbers

501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524
525	526	527	528	529	530	531	532	533	534	535	536
537	538	539	540	541	542	543	544	545	546	547	548
570	571	572	573	574	575	576	577	578	579	580	581
582	583	584	585	586	587	588	589	590	591	592	593
594	595	596	597	598	599	600	601	602	603	604	605
606	607	608	609	610	611	612	613	614	615	616	617
618	619	620	621	622	623	624	625	626	627	628	629

Please print 2/60

NAME .....

TITLE .....

COMPANY .....

CO. ADDRESS .....

CITY ..... ZONE .... STATE .....

For Advertisements—Circle Page Numbers

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	187	189	191	193	195
197	198	201	203	205	207	209	212	213	214	215	216
217	219	220	221	222	223	224	225	226	227	228	229
230	231	232	233	234	235	236	237	238	239	240	241
242	243	244	245	246	247	248	249	250A	250B	251	252
253	254	255	256	257	258	259	260	261	262	263	264
265	266	267	268	269	270A	270B	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286A	286B
287	288	289	290A	290B	291	292A	292B	292C	293A	293B	293C
293D	294	295A	295B	295C	295D	295E	295F	296	298	299	300
701	702	703	704	705	706	707					

COVERS: FRONT — INSIDE FRONT — INSIDE BACK — BACK

For New Equipment, Catalogues—Circle Item Numbers

501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524
525	526	527	528	529	530	531	532	533	534	535	536
537	538	539	540	541	542	543	544	545	546	547	548
570	571	572	573	574	575	576	577	578	579	580	581
582	583	584	585	586	587	588	589	590	591	592	593
594	595	596	597	598	599	600	601	602	603	604	605
606	607	608	609	610	611	612	613	614	615	616	617
618	619	620	621	622	623	624	625	626	627	628	629

Please print 2/60

NAME .....

TITLE .....

COMPANY .....

CO. ADDRESS .....

CITY ..... ZONE .... STATE .....

information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogs, data on new equipment described, and products advertised in this issue. In the Information Guide section immediately preceding these cards advertisers are listed by product group to facilitate location of advertisements on which you desire additional data and catalogs.

This card expires May 1, 1960

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MACHINERY
93 WORTH STREET
NEW YORK 13, N.Y.

READERS' SERVICE DEPT.

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New York, N. Y.

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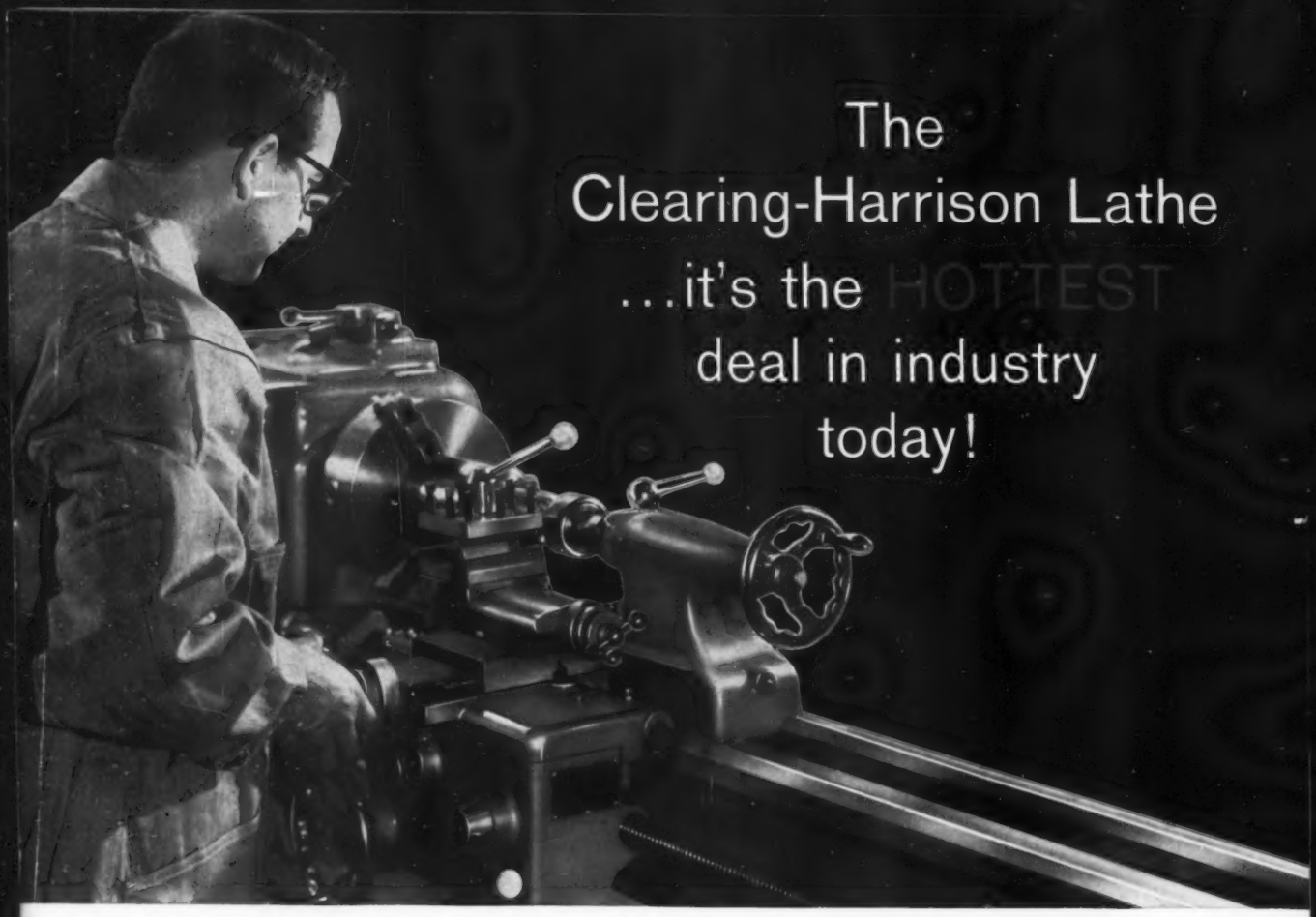

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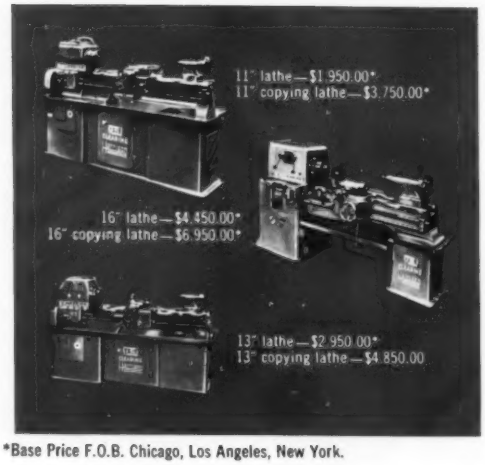

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